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FROST FIGHTING.*

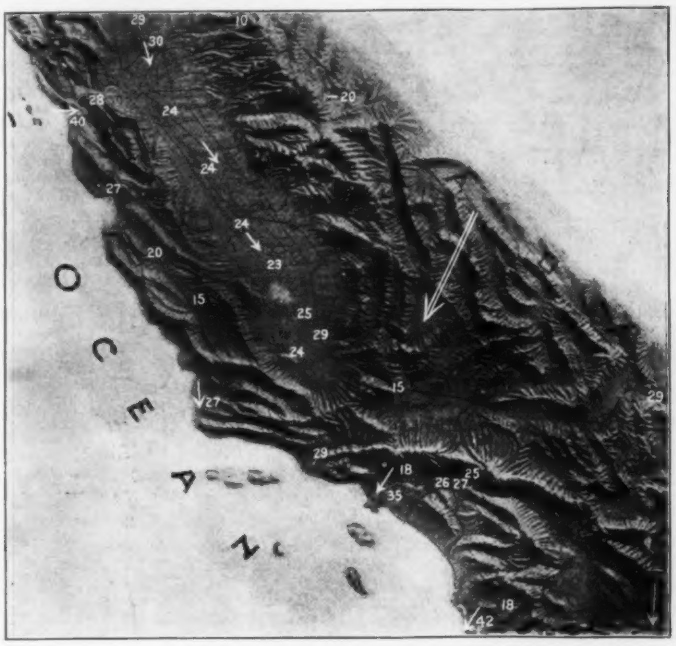
By ALEXANDER G. MCADIE, Forecast Official, United States Weather Bureau.

FOR the past four years the Weather Bureau office at San Francisco, has given much attention to the question of protecting the citrus fruits of California, particularly of the section south of the Tehachapi, from frosts. It has been estimated that the value of the citrus fruit crop for this section during the year 1899, was in the neighborhood of $7,000,000. It will be readily seen that even if so low a proportion as five per centum of the crop should be lost through frost, the amount involved is still so considerable as to warrant a systematic study of the problem and an endeavor to devise methods minimizing this loss. The problem is of a twofold nature: first, accurate forecasting of the frost period; second, efficient methods of raising the temperature at critical times. The Weather Bureau office at San Francisco has demonstrated beyond criticism that frost can be successfuly forecast. Certain fruit growers, and particular credit should be given to the Riverside Horticultural Club for its work in this direction, have both devised and tested methods of smudging, irrigating, heating, covering, etc., of great practical value.

The experience of the past three years warrants the statement that the loss due to frosts in California, hitherto considered unavoidable, can be prevented, and that unless extreme conditions, by which is meant lower temperatures by 5° than have ever yet been experienced in this State, occur, the citrus fruits of California can be successfully carried through the period when frost is likely.

It should be noted at the outset that in many sections, for some years past, it has been the practice to call certain areas frostless. Many of the foot-hill sections are advertised as regions in which frost has never been known to occur, but such statements must be received with caution and reliable records insisted upon. For reasons which will be given later in connection with the matter of "Air Drainage," it is plain that places which are exempt from frost one season may be visited with frost at another time, and that a slight shifting of the lower air currents is responsible for much of the streakiness so characteristic of frost. The surface drainage of the air is not a fixed condition and consequently a region which is frost free under some conditions may be visited with frost when these conditions are slightly altered. In general, then, no section in districts where frost does accur is to be considered as frost proof.

The chief result of the work in California during the past four years is the establishment of the principle that the formation of frost is primarily a matter of air drainage. This principle is shown both in the general pressure distribution over the southwest portion of the country during frost periods, and on a smaller scale in the motion of the surface air currents in certain small areas. A composite map showing the conditions preceding frost was prepared in December, 1899.*



RELIEF MAP SHOWING EXTREME MINIMUM TEMPERATURES DURING FROSTS INJURIOUS TO CITRUS FRUITS.

* Prepared under direction of Willis L. Moore, Chief United States Weather Bureau.—Bulletin No, 29.—W. B. No. 219. United States Department of Agriculture, Weather Bureau.

* The map is a composite of many dates which were followed by heavy or killing frosts within twelve hours. It should be studied carefully by orange growers; and from the beginning of December to the end of the frost season

WIRE BASKETS IN CITRUS GROVE.

WIRE BASKETS HUNG FROM LIMBS OF ORANGE TREES.

EIGHT MINERS' INCHES OF WARM WATER IN ORANGE GROVE AT MEACHAM RANCH.

WIRE BASKETS IN LEMON AND ORANGE GROVE.

A relief map of southern California used in connection with the pressure map will show that the air moving from the north through El Cajon Pass, or over the San Bernardino Mountains, drains southwestward into the districts which are the center of the citrus fruit industry in southern California. When this cold, dry air settles in these lower lands, the temperature near the ground about the time of sunrise will range from 22° to 32°. An important relation, first pointed out by Prof. W. H. Hammon, for forecasting frosts for southern California is this: A wave of falling pressure passes from Montana or Idaho southward across Utah and westward through southern Nevada, thence into Arizona or southern California, and if followed by a rapid rise in pressure, is generally the forerunner of much colder weather in the southern citrus belt. In other words, the usual warm lower air strata are vigorously displaced by cold, dry air; and when the draining ceases and the cold air settles during the period of comparative stillness, frost forms. What is true on a large scale is true on a smaller scale, and a close agreement exists between frost belts or frost streaks and areas of stagnant cold air. An attempt has been made to plot the channels of air motion and the frost streaks in certain districts. Mr. Frank H. Olmstead, acting for The Los Angeles Daily Times, surveyed the frost localities in Los Angeles, Riverside, San Bernardino, and Orange Counties. The survey was necessarily a hurried one; but the correlation of frost streaks and stagnant air was evident. A careful survey should be made by every ranch owner. The writer has urged this matter, believing that each grower must work out his own salvation, and that besides studying and practising methods of protection, it is necessary to be familiar with the air drainage of the ranch. In nearly every ranch that the writer has visited there have been certain well-marked cold spots which, in most cases, were found to correspond with slight depressions in the ground. These three deductions can be drawn from what precedes: (1) Where the air is in brisk motion damage from frost is generally light. (2) Stagnant air, such as exists in low valleys, basins, and inclosed areas, favors frost. (3) As the coldest layer is generally near the ground, it is sometimes advisable to drain downward upper, warm air, displacing surface layers.

In studying frost formation it must be remembered that if there is little aqueous vapor there will be but a small quantity of frost. The temperature of the air, however, may be sufficiently low to seriously injure vegetation. This explains why with low temperatures and low dew-points in certain regions, especially where the radiation of heat is very rapid during the night hours, there are no frosts. It is too dry. Conversely, high dew-points and much moisture in the air sometimes are followed with heavy frosts, although the air temperatures range between 40° and 45°. These points are mentioned to answer the questions which are often propounded, why with low temperatures there is no frost; or why there is no frost one morning and there is frost on a succeeding morning when the temperature is perhaps higher. Distinction must be made between the deposition of the moisture in the air and the temperature of the air itself.

METHODS OF PROTECTING.

Every fruit grower should put himself in communication with the nearest center of distribution of weather forecasts. If possible he should be in daily communication with some Weather Bureau office. Whenever frost warnings are issued for his locality he should carefully determine the temperature and dew-point, as elsewhere described, frequently during the late afternoon and night. A good outfit consists of a metallic thermometer so arranged as to automatically close an electric circuit and ring an alarm whenever the temperature of the air reaches 32°. In addition to a reliable sling psychrometer, there should be some small device for testing the motion of the gentle air currents in the orchard. Too much attention can not be given to this question of air motion. Many smudging devices have failed to be effective because of a slow movement of the smoke away from the orchard.

PROTECTIVE METHODS BASED ON MIXING THE AIR.

It is well known that lowlands are visited with frost while hillsides and hilltops escape. Every fruit grower should study the topography of his land plant accordingly. Wind-breaks are, as a rule, considered detrimental. No hard and fast rule, however, can be laid down. On a well-known lemon and orange ranch at Santa Paula, the property of Mr. N. W. Blanchard, there are several large wind-breaks which have proven themselves to be of the greatest benefit in protecting fruit from frost. It would almost seem as if the citrus trees within a distance of 50 feet were directly protected by these wind-breaks. By planting a windbreak in the proper place, defects in the topography may be overcome and air currents established where otherwise pools of quiet air would have formed. A wind-break dense enough and so situated as to interfere with any natural circulation and facilitating the formation of still areas or pools would, of course, prove injurious.

PROTECTIVE METHODS BASED ON WARMING THE AIR.

A large number of small fires, advantageously placed, will raise the temperature of the air several degrees. The Riverside Horticultural Club, testing the various methods which were in use in California, came to the conclusion that wire baskets suspended a few feet above the ground, and holding several pounds of coal or charcoal, made an efficient protector. This method was described by Mr. Edward Copely, of Riverside, Cal., in several articles published in The Riverside Press of April, 1896. The cost of the wire basket is about ten cents, and if forty baskets be used to the acre, the cost of fuel will hardly exceed $2.50. To this must be added the cost of labor during the night and succeeding day in refilling the baskets. In the illustrations, the baskets are shown in position. This method meets with most favor in southern California. The temperature can be raised certainly 3° or 4° with from twenty to forty of these baskets to the acre. It has been suggested that a number of small oil lamps be used with success for this purpose. Oil pots have been used and make a hotter fire, but the deposit of lampblack upon the fruit is objectionable. Some cheap modification of the ordinary plumber's furnace might possibly be devised which, by means of a moderate blast, would produce a high temperature.

LATH SCREEN AT RANCH OF MR. A. J. EVEREST, RIVERSIDE, CAL. (UNDER VIEW.)

PROTECTIVE METHODS BASED ON CLOUD OR FOG BUILDING.

Damp straw, old wood, prunings, manure, etc., when burned briskly furnish an effective smoke, and if the material while burning is doused with water, the result is a dense steamy smoke, which, while trying on human lungs, serves as a screen to prevent loss of heat by radiation and as a barrier between the chilled fruit and a sudden application of heat at the time of sunrise. Wet smudging has been tried in many ways with varying results. There are many reports of failure, and on the other hand, some definite results, showing the good accomplished by this method. Here, as in all other methods of protection, much will depend upon a careful study of the local conditions. Many a farmer smudges so that some neighbor gets the benefit of his work while his own fruit remains unprotected. All motion of the air should be noted carefully, and this is sometimes difficult where the smoke is very dense. In some orchards sacks of old straw soaked with oil are so distributed as to be available for quick lighting. Portable smudges have also been devised.

Mr. Hall has made an efficient form of sled operating under the wet smudge principle. Upon a sheet of iron sled he has placed a small firebox, consisting of a grate 4 or 5 inches above the bed of the sled, over which pass iron rods bent in the form of an arch, leaving a space for the fire about 14 inches in diameter. This firebox is inclosed in a large corrugated iron box, which has the bed of the sled (about 3 or 4 feet in size) for a bottom, and sides 30 inches high. A door is made in front of the corrugated box to admit fuel to the fire. The box is filled with wet straw or manure and a fire is maintained in the firebox when the machine is in operation. The cost is about $12; one will do for ten acres.

PROTECTIVE METHODS BASED ON IRRIGATION.

Of all methods proposed for the protection of fruit, excepting wire baskets, irrigation has the largest amount of evidence in its favor. It has been tried in many different places with different crops and has generally given satisfaction. Where water is not very plentiful, and this is the case strangely enough in some fruit sections, the method may not always be practicable, but with this exception there are many decided advantages in the generous use of water. Injury from frost depends almost as much upon the condition of the tree as upon the severity of the weather. Critical periods in the life of the tree can be controlled to some degree by the use of water.

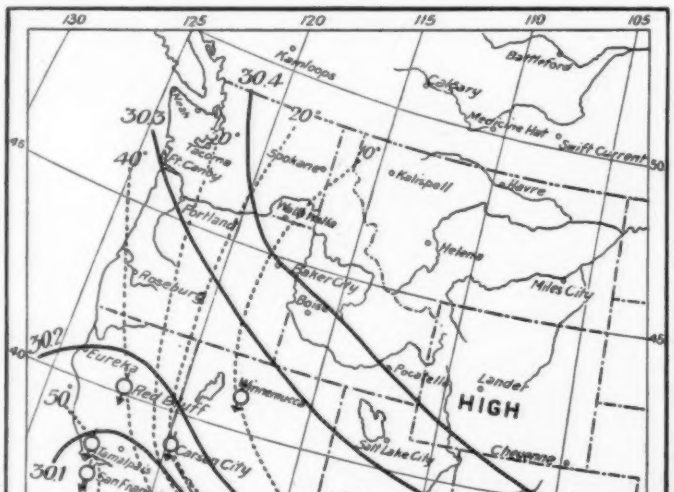
Some fruit growers hold that heat is the one thing that is desired at times of frost, and that the best method is that which produces heat by the simplest and least expensive process. Water, owing to its high specific heat, forms an excellent agency for the temporary storage of heat energy. We have seen that in the wet smudge an attempt is made to utilize the latent heat of vaporization, and theoretically this has always seemed the most advantageous method. A modification of the wet smudge is steam piped through an orchard. This experiment was made by the Wright Brothers at Riverside, Cal., with a 35-horse power boiler and a main pipe 2 inches in diameter, from which, at right angles every 40 feet, pipes three-quarters of an inch in diameter were extended. It is claimed that the temperature was raised 3 degrees whenever the steam was turned on. It is also said that the coal consumed would not be more than the amount used by the basket method. The estimated expense per acre would be about $75.

The latest device for the protection of citrus fruit against frost combines the good effects of irrigation with heating. This is a method known as the warm water method, tried at Riverside this year. An account of the experiment follows:

"EXPERIMENT OF MR. ERNEST A. MEACHAM, RIVERSIDE, CAL.

"On the morning of February 9, 1900, at the Meacham ranch, a test was made of the Meacham warm water method of protecting citrus fruit against frost. The experiment began at 3:45 A. M., and was conducted in the presence of a number of gentlemen belonging to the Riverside Horticultural Club, nearly all of whom were orange growers.

"At 6:30 A. M. the temperature of the ground 100 feet or more away from the boiler was 32°. The temperatures given herewith are those obtained by Mr. McAdie of the Weather Bureau with sling psychrometer No. 70; the number of the dry thermometer was 4487 and of the wet 4486. The plant consists of a 12-horse power tubular horizontal boiler, laid in a brick



COMPOSITE BAROMETRIC AND THERMOMETRIC CONDITIONS FOLLOWED BY HEAVY OR KILLING FROSTS WITHIN TWELVE HOURS.

the daily weather maps issued at San Francisco and Los Angeles should be carefully compared with this map. In brief, the condition preceding frost is the passage of a low area from Idaho southward across Utah, westward through southern Nevada, and southward into southern California, followed by a marked high. For the most part frosts are due to the movement of the cold air from the northeast. Frosts also occur when a low over southern California moves rapidly southeast, and is followed by a high from northern California. Conversely, when air moves from the sea inland, i. e., when the breeze is from the south and west, there is little danger from frost.

furnace, and arranged to deliver water with or without pressure. Cold water enters the bottom of the boiler and is delivered from the top orifice directly into the flume. The fuel used was crude petroleum, of which about 50 gallons were used in three and one-half hours. At the rate of 14 gallons an hour and an estimated cost of a little over 4 cents per gallon, the actual expense of fuel for the experiment was about 60 cents per hour. The oil is burned with a steam jet under a pressure. A secondary 6-horse power boiler, carrying 70 pounds of steam, was used. The oil is thus entirely consumed and makes but little smoke. The whole arrangement is such that not more than two men would be required to attend to all the details.

"Fifty minutes from the time of beginning, the water which had an initial temperature of 55·4° was raised 30°. Two sets of temperature records were made, one by Mr. Priestley Hall and the other by Mr. McAdie. In Mr. Hall's test 8 inches of water was run in fifty furrows, which barely ran the water past the ends of the furrows. In the second case 8 miners' inches of water was delivered into twenty-five furrows, thus carrying the heat farther down the furrows than in the first experiment. According to the present laws of California, a miners' inch is $\frac{1}{50}$ cubic foot per second; the second foot is the quantity represented by a stream 1 foot wide and 1 foot deep, flowing at the average rate of 1 foot per second. A cubic foot of water, maximum density, weighs 62·4 pounds; a gallon contains 10 pounds of distilled water at 62°. The data obtained by Mr. Hall were as follows: 5:30 A. M., normal temperature, 34°; normal temperature of water, 60°; temperature of heated water, 92°; at the flume, 92°; 20 rods from the flume, 58°; 40 rods, 52°; temperature of unheated water 40 rods from the flume, 41·5°; vapor condensed on trees early in the morning and more condensed on the trees in the heated plat.

"Mr. McAdie's records are as follows: Time, 6:30 A. M., air temperature varying from 34° to 36°; temperature on the ground, 32°; frost was observed on the grass blades; initial temperature of water, 55·4°; heated water delivered to flume at 85·2°; in a straight line down a furrow, 200 feet from the boiler in the direction of the wind (motion of the air was very gentle), there was a fall in temperature of 14·2°; water vapor was observed rising to a height of about 4 feet; 200 feet from flume, as stated, the temperature of the water was 71°; the temperature of the surface soil 4 inches right and left of the water was 43°; temperature of the soil 16 inches from the water or in the middle of the ridge, 42·2°. It is presumed that the temperature of the ground, had no water been flowing, would have been 33°, and it would seem as if the soil itself was warmer by nearly 10°. At the end of a furrow, 660 feet, the temperature of the water was 54°, or there had been a fall of 31° in 40 rods; the temperature of the ground 4 inches from the water, 38°; 16 inches from the water, 36°; temperature of unheated water 50 rods from the flume, 40°.

"The approximate value of the plant was $200, and it is estimated that for a ten-acre grove $600 would cover all expenses."

SPRAYING.

After frost, or rather just before a frost has ended, a spraying device can be used to advantage. Its chief function is to prevent a too rapid warming of the chilled fruit. It is said by horticulturists that even the light coating of ice formed in this way does not seriously damage the fruit. It is very likely that the latent heat of solidification set free by the change from water to ice may play a helpful part; but the chief effect is to prevent a too rapid thawing. In other words, both heat and water should be supplied to the chilled plant slowly, and according to the plant's ability to make good use of the same. At the A. J. Everest ranch at Riverside, Cal., a portion of the grove is protected by sprinklers at the top of fifty-foot masts.

PROTECTIVE METHODS BASED UPON SCREENING OR COVERING.

All screening or covering devices are in effect modified hothouses, and there is no question but that a thorough protection can be accomplished. The expense is the one objection. Screens are made of light materials, namely, canvas, muslin, or light wood work, and have been used with considerable success. At the A. J. Everest ranch an elaborate structure of lath screens is in use, illustrations of which are given herewith. There is no question as to the value of the protection, but the expense is considerable, averaging perhaps $400 to the acre. This lath covering may be considered as forming a well ventilated hothouse.

REQUIREMENTS OF ARABLE LANDS FOR PHOSPHORIC ACID.

From the French of M. A. PAGNOLD, Superintendent of the Agricultural Station of Arras.

IT is admitted generally that the normal richness of good arable lands in phosphoric acid is one per cent.; that below this limit the land requires phosphates, and that above it an addition of these salts is useless. This opinion, insisted on by some practical men, is denied by others.

Having at my disposal forty-four samples of soils collected in the canton of St. Eloi, of which complete analyses had been made at the station, I availed myself of the opportunity to examine the question anew.

At the outset it appeared to me that the line to be drawn between lands requiring the addition of superphosphates and those having no further need ought to have reference to their richness in assimilable phosphoric acid. It is true that, as yet, we have no direct means of ascertaining the proportion of the phosphoric acid called assimilable, and that the designation itself is far from having an exact signification. I therefore confined myself, in estimating it, to the employment of a weak organic acid, following the course described in the bulletin of the station for 1898.

All the samples that by this process yielded less than 1 milligramme of assimilable phosphoric acid for 100 grammes of soil were placed by themselves. They numbered fourteen;* ten had yielded nothing, the average being 0·13 of a milligramme.

The twenty samples that yielded higher proportions were placed in another lot. The figures varied from 1·2 to 17·6, the average being 6·18 milligrammes.

The total proportion of phosphoric acid in the samples was also determined, and the average in milligrammes per 100 grammes of soil were in the two lots respectively:

Total in the first lot, 89·00; in the second lot, 160·50. Assimilable phosphoric acid in the first lot, 0·13; in the second lot, 6·18. The acid was thus deficient in the first lot, and in excess in the second.

The soils were distributed in four compact stoneware vessels, of a capacity of four kilos, in the following manner:

1. Poor soil of the first lot.
2. Rich soil of the second lot.
3. Poor soil, with the addition of three grammes of superphosphate.
4. Rich soil, with the same addition of superphosphate.

In each vessel three grammes of red clover seed were planted on May 4. Considerable difference was noticed as soon as the clover appeared above the soil. The results obtained on harvesting (June 15) were as follows, the lowest yield being represented by the figure 100 as an easy method of comparison:

Soil poor in phosphoric acid, yield 100, soil rich in phosphoric acid, yield 261; the poor soil, with three grammes of superphosphate, yield 315; the rich soil, with three grammes of superphosphate, yield 480.

Comparison of vessels Nos. 1 and 2 prove the great superiority of lands rich in phosphoric acid; that of vessels 1 and 3 show that the poor soil, with an addition of three grammes of superphosphate, has tripled the yield; results which might have been expected. But the comparison of vessels Nos. 2 and 4 show that on a soil rich both in the total amount of the phosphoric acid and in the assimilable acid, the addition of the superphosphate has still nearly doubled the yield.

If now we apply to the hectare the figures obtained by an analysis of the soils, estimating at four millions of kilos the cultivable land of a hectare, the assimilable phosphoric acid of the first lot would be only 5·2 kilos for that surface, a quantity insufficient for requirements. The richness of the second lot would, on the contrary, correspond for the same surface to 247·2 kilos; that is to say, to an amount of assimilable phosphoric acid sufficient for seven or eight crops. On the other hand, the three grammes of superphosphate added to the six kilos of soil would, for the hectare, represent 235 kilos of soluble phosphoric acid.

It is seen, therefore, that in a soil already containing a large excess of assimilable phosphoric acid, a considerable addition of this acid may still greatly increase the yield.

The rootlets of the plants can only absorb a small portion of the available phosphoric acid; hence the necessity of a large excess.

The average quantity of nitrogen in a hectare of our lands of Pas-de-Calais is 5,200 kilos. The nitrogen is insoluble in the soil, and is taken up slowly according to the needs of the plant. The soil at any given moment contains scarcely 2 milligrammes in 100 grammes, that is, about 80 kilos to the hectare, and it would be soon exhausted by the percolation of water, were the transformation more rapid.

This is not the case with soluble phosphates. These are not so readily diffusible in the soil, and have rather a tendency to pass to the insoluble state, which allows of their employment in excess without danger of waste, at the same time rendering an excess needful.

In fine, the limit of one per cent. of phosphoric acid cannot be admitted, at least for clover; it might be raised to at least two per cent.; or rather, taking assimilable phosphoric acid for the calculation, it might be raised to 10 or 12 milligrammes for 100 grammes of soil. These limits would probably be the same for other leguminous plants, but could, without doubt, be lowered for cereals, and possibly for beets.†

* Note by Translator.—This figure is given as 14 in the original; it evidently should be 24, to make out the full number of samples (44); for if the difference were added to the second lot described in the next paragraph, as otherwise it would have to be, the disproportion of the four (4) productive samples of the first lot would be very great in the subsequent comparisons. If the error is not purely typographical, it may have arisen by taking inadvertently the productive samples, which would number 14, if the whole number were 24. The productive samples are the only ones entering into the calculations. The result of the experiment is not affected, except that a comparison of 14 samples with 20 would be more conclusive than a comparison of 4 with 30 samples. To consider the entire number of samples analyzed as reduced from 44 to 34 would be still more objectionable. It may be proper to say that French commercial writers or printers are very apt to use a figure for an isolated round number where a single word fully spelled would be a guard against the misconduct of the types, and afford a convenient distinction where there is an accompanying set of numbers or a calculation properly requiring figures. American editors and translators are sometimes criticised for the reproduction of an article thus rendered partly unintelligible to their readers.

† It may be of advantage to remind readers desirous of giving more than a casual perusal to this article, that the milligramme is the thousandth part of the gramme (the unit of French weights), which latter is the equivalent of 15·433 grains, and that the kilogramme (abb. kilo, kil., k.; plur. kilos), consisting of one thousand grammes, is equivalent to 2·2046 lb. av. The hectare is equivalent to 2·4711 acres.

WONDERFUL FEATS OF THE HATA YOGI.

By Dr. T. J. BETIERO.

THE Star of Magi for March has the following interesting article on "Oriental Adeptship."

The Brahmin Hindoos have such a great number of commentaries that the most learned Brahmin can scarcely reach the tenth part of them during a lifetime.

Leaving aside the four books of the Vedas, the Sanscrit Puranas, consisting of 4,000,000 stanzas forming eighteen volumes, treat of laws, theology, medicine of the creation, the destruction, regeneration of the world, etc. The Shastras treat of mathematics, grammar, etc. Oupavedas, Oupanichados and Oupopuranos are keys or explanations of the foregoing. Also twelve large books which contain the Laws of Manu, the grandson of Brahma, relating to penal and civil laws, and canonical rules for the adepts.

Brahminism was originally monotheistic, but the priests have added many rules and made changes, introducing an unlimited number of absurd gods, goddesses, semi-gods, genii, angels and demons, all represented by an equal number of repulsive idols.

Buddhism teaches right thought, speech, belief, doctrine, means, endeavors, livelihood, memory and right meditation. A code of morals existed six centuries before the Christian era, and there is less crime in India, in proportion to the population, than elsewhere.

The Brahmins fervently desire power and peace. They drive out earthly ambition, desire for sensation and all selfishness; they desire only the subjective world—that which is within themselves. These desirable characteristics cannot be applied to Hindoos as a race, as one will find among certain classes as much ignorant superstition and uncleanliness as elsewhere.

They are supposed to take a daily bath but many use filthy pools, which are no more than mud holes.

If you speak to an ordinary Hindoo concerning the inner man he will generally show an ignorance that is either feigned or real.

The Raja Yogi have, however, the most sublime teachings of earth. Their objective life seems dissolved; they must live neither in the present nor future, but in the eternal. The true Raja Yogi must stand alone. Nothing that is out of or away from the eternal can aid or benefit him.

There is an opposing sect called the Hata Yogi, who also seek development: they practise physical exercises and incarnations which would have no charm whatever for the student of the Occident. From these the fakirs of India are usually recruited. Along the highways and in the bungalows members of this sect are often met, sitting in various postures, which they have maintained for years. Many are seen with a hand held up, who have held it thus for years, until it has almost completely withered away. . . .

Buddhism has undergone the same modifications. The great reformer, Sakhya Mouni, inspired by the Supreme Judge, truly understood the indivisible majesty of Brahma, and did all in his power to prevent the manufacture of images made in his resemblance. He openly separated himself from the polytheistic Brahmins and preached the purity and immortality of Brahma. The success attained by himself and followers caused him to be persecuted by those Brahmins who acquired a revenue from the manufacture of idols, and who oppressed the people.

The first sacred preachers were called Buddhas (saintly or learned), because they were regarded as incarnations of the divine one. They dwelt in different parts of the world, and their sermons were mainly directed against the tyranny and profitable methods of the Brahmins. The Buddhists—those who followed the Buddhas—were mostly among the lower classes of China and India. Among the sacred Buddhas are two who are particularly venerated, Sakhya Mouni, known in China under the name of Fo or Kong Fo Chee, which latinized gives us the better known name of Confucius, lived about 3,000 years ago. I would advise anyone who wishes to read good, wholesome philosophy to read the analects of Confucius. The other was called the Buddha Gautama. He lived about 2,500 years ago and converted nearly half of the Hindoos.

Buddhism is divided into many sects, which differ only in religious ceremonies. The basic doctrines are the same in all. The Thibetan Buddhists, called Llamas, separated from the Foistis 1,500 years ago. Later, a Mongolian, Khutuktas, translated the works of the great Buddha into Chinese, for which the Emperor of China rewarded him with the title of Go-Chi (king's preceptor). After his death this title was bestowed upon the Dalai Llama of Thibet, and it is retained even to the present day.

The Buddhist religion in Thibet is called Llamaism (superior). Both red and yellow monks are admitted. The former marry; the yellow are celibates.

The Hindoo records give the chronology of the Buddhas as follows: Three thousand years ago the Great Buddha in the person of the celebrated Sakhya Mouni, propagated the doctrines of his twenty incarnations Two thousand five hundred years ago Gautama built the foundation of a new world in Burmah, Siam and different islands. Shortly afterward Buddhism began to penetrate China.

About the year 2050 the doctrine of Sakhya Mouni was adopted by the people. At the same time the doctrine began to spread among the Israelites.

Buddhism teaches reincarnation, rebirth, and the pure doctrine of Karma. The ten stages of Yogi development are much like an estatic dream.

The Yoga exercises for the development of the soul or inner man, are both physical and mental. A strict observance of such rules of life as will make one a better man—physically, morally and spiritually—is insisted upon.

NEW THEORIES OF PLAGUE PROPAGATION.

THE apparently mysterious manner in which the bubonic plague spreads itself to distant and widely separated localities gives becoming interest to any new theories explaining such methods of propagation.

When it is considered that much of what is now known concerning the character of the scourge has been learned since 1894, when the specific bacillus was discovered by Kitasato, the profession can congratulate itself that very much has been accomplished in solving many of the apparent problems which attached themseves to propagating qualities of this direful scourge. The isolation of the plague microbe was the first step in this direction. Then followed the various experiments by numerous observers in connection with inoculation tests and the more minute and careful examination of autopsical lesions as bearing upon their relations with symptoms and the way in which the disease spreads in accordance with the modern views of pathology.

So far it may be definitely stated that the plague bacillus is the specific cause of the disease. This has been abundantly proved by the usual bacteriological methods of isolation of the micro-organism, its cultivation, its inoculation into animals, the transmission of the bacillus through their bodies, and its final recovery from the dead victims. The latest theories of the propagation of the disease are quite exhaustively presented in the work of Dr. José Verdes Montenegro,* of Madrid, who, in connection with other important studies of the disease, has summarized his experience with the Oporto epidemic.

The rat is acknowledged to be a chief factor in the

* "Bubonic Plague: Its Course, Symptoms, and Means of Prevention and Treatment," by Dr. José Verdes Montenegro, Ex-Interne Central University of Medicine and Professor at Municipal Micrographical Laboratory, Madrid. Translated by W. Munro, M.D., Medical Officer St. Kitts, W. I. New York: William Wood & Company. 1900.

dissemination of the disease, as this animal is peculiarly liable to infection through the intestinal canal and is notoriously migratory in his habits. Montenegro asserts that the plague is simply a disease of rats which infects man. According to the observations of Simon, the epidemic among rats follows a course analogous to that in man. After a period during which the cases are not very frequent the plague becomes suddenly very severe with a consequently increased mortality. Thus it happens that before the disease attacks man large numbers of dead rodents are found in the houses and streets of a threatened district. This was the case in Mandvi, where the street arabs amused themselves by using the dead animals as missles in play.

Curiously enough Simon has discovered that preceding the rat in initiative causative influences comes the rat flea, which appears to have the real credit of starting the humble bacillus in its ambitious tendencies for better company. Simon says that a healthy rat has very few fleas on it, but the sick animal becomes very soon covered with them. The insects become gorged with bacilli and transfer the disease not only from one rat to another, but also to man.

While this very ingenious theory might explain quite satisfactorily why some sporadic cases appear in widely separated localities, it does not seem capable of accounting for the actual explosion of an epidemic which is evidently due to the varied conditions of human infection. It must be admitted with all our recent knowledge on the subject of propagation of the disease gained by those who have had large experience with the plague, that we have not yet arrived at safe or definite conclusions upon the subject. Whether or not the disease is contagious or infectious, whether or not it depends upon soil or house contamination, we certainly know one thing, that an epidemic when once started burns like a devouring fire madly reaching for available fuel. The epidemic influence, whatever it may be, gives the virulence of the disease a new force and a new purpose. If we rule out the latter condition and confine ourselves to the study of isolated cases, the conclusion seems almost irresistible that the real danger of directly communicating the disease from person to person is very much exaggerated.

It does not appear to be distinctly contagious in the sense in which that term is now used. There is great probability, however, that it is markedly infectious under certain circumstances of careless contact. This is most frequently manifest in cases of autopsy, in which the operator becomes infected through accidental wounds coming in contact with the blood and secretions of the corpse. Two of Kitasato's assistants acquired plague that way. The experiences in the Vienna laboratory, still fresh in the minds of medical men, were on parallel lines. It is quite assuring to know, however, that physicians, nurses, and undertakers who come most in contact with plague cases are seldom stricken when proper aseptic precautions are taken. The danger appears more in the direction of actual contact, actual and direct transmission of virus, than by any other means. But a most ready means of transmission of the disease is by house infection, which by many high authorities is considered to be the underlying and controlling factor in all wide-spreading epidemics.

Regarding human infection the same laws govern as in similar communicable diseases. With plague the most direct avenue of infection appears to be by inoculation or by the transference of the germ to the naso-pharyngeal mucus. Next in order come wound infection, contact with articles of soiled clothing, utensils of sick room, sputum or dejections generally, and, last and perhaps least of all, constantly breathing the air of the sick chamber. It is by no means proved that the intestine can be infected as in typhoid, as numerous experiments on animals have proved the negative side of this question.—Medical Record.

THE ART AND CRAFT OF GARDEN MAKING.*

DURING recent years we have had at almost regular intervals a new book on landscape gardening. In our own language, English and American, we have had at least a dozen books on the subject since the days of Repton and Loudon, and not a few from France and Germany. This redundance of literature either shows that the art is rapidly progressing, or that each author has thought that previous writers had not dealt with the subject as it ought to be treated. We fear that the latter assumption is accountable for this activity of writers.

The perusal of this, the latest book, leaves us with the impression that, while the art is really progressive, the literature devoted to expounding its principles and practice is not so, and that the present author has added but little to the literature of the art. This will be apparent to all who have studied the works of Price, Repton and Loudon, written in the early days of the century; the practical works of Major and Kemp in the middle of it; and the prolific crop that has appeared toward its close, including that very comprehensive treatise, "L'Art des Jardines," by M. André.

Everything in this present book will be found to have been dealt with in the works by these authors, though perhaps not embodied in such a handsome volume. Nor had they (the authors) the opportunities of the present day in illustrating their works by photographic reproductions, which render a work attractive.

The ideal book on modern English landscape gardening would be one that, while it embodied the best from all that preceded it, would deal judiciously with the vegetation with which our gardens have been enriched during the present century. He is the true landscape gardener who possesses a thorough grasp of this abundant material, and can plant a garden which would give the fullest expression of beautiful growth suitable to its peculiar soil, climate or situation. It is this want of knowledge, and this over-abundance of variety, that makes present day gardens, planted in the common way, so distracting, solely on account of the inability of the planters to select their material and arrange it in a tasteful way.

* By T. H. Mawson, Garden Architect, Windermere. (B. T. Batsford, High Holborn; and G. Newnes, Limited, Southampton Street, Strand, W. C.)

Skillful planting is the very essence of landscape-gardening; and just as a landscape painter must have a thorough command of the pigments on his palette, so must a planter know his material as thoroughly, for no matter how correct the drawing is in the one case, and how perfect the design or plan in the other, the success of the picture depends upon the arrangement of color and form.

The author of this book apparently subordinates planting to plan, as his chapters on the subject are the weakest in the whole book; whereas all who have practiced landscape-gardening successfully will agree that the planting of a garden is the least difficult part of the art, and that formal garden planning is a simple matter. The work that requires the greatest care, forethought, knowledge and taste is the planting of a garden in a natural way, so that the parts shall blend in perfect harmony, creating here leafy and shady glades, there masses of effective coloring—every tree, shrub, and flower being adapted to the particular spot where it could display its full growth and beauty. Such a garden, producing an ever-varying scene of infinite variety and delightful intricacy, is in truth a place for sweet retirement and pleasure, rather than the formal plateau, where there is no variety of light and shade, and where the whole design can be seen at glance.

The author has evidently a very decided leaning toward what is termed architectural or formal gardening, as opposed to the natural style, which, carried out on the true principle of the art, constitutes the English garden, originated in England, known throughout the world, and copied in every country from Japan to California, and on which we justly pride ourselves. We hope he is not among those who have been lately making strenuous efforts to revive mediæval gardening, not in its simplicity and quiet dignity, which we all admire in beautiful old gardens, but accompanied with such absurdities as topiary work, which one would have thought had disappeared utterly from English gardens under the seathing ridicule of Pope and others.

TERRACE WALK & HERB GARDEN FOR WALTR. WHITEHEAD ESQ.

These advocates of formalism seem to premise that no garden is possible which is not confined by straight lines, generally of costly masonry walls bedecked with insipid ornament; that no water is ornamental which is not confined by rectangular or symmetrical inclosures; that no tree must be allowed to assume its natural growth, but be clipped and pruned into fanciful forms. This was perhaps in keeping with Tudor days, when the dearth of garden vegetation was an inducement to produce variety by the shears, and make a garden different to outside wild Nature.

Formal gardening, carried out with simplicity and dignity, is often beautiful; badly conceived and carried out, it is execrable. It is the most costly in its construction as well as in maintenance of all styles of gardening, and in these utilitarian days these are the chief considerations. The fanciful sketches the author gives of formal gardens may be alluring to the unwary; but those who know that it takes a lifetime to form an archway in Yew, for instance, and the work entailed in keeping clipped hedges and masonry walls in order, will decide for themselves which style to adopt. The criterion of a landscape gardener's skill is furnished not by imaginary sketches and plans, but unerring photographs of his work taken at reasonable intervals after completion.

Terrace gardening receives a deal of attention in this work. This is a very contentious subject between the architect and landscape gardener, and the continual feud between them chiefly arises from this point. In the immediate surroundings of a house it is often necessary to have a level plateau, but the size and form of this, if it at all affects the house itself, ought and should be designed by the architect of the house, who should best know the right proportions of base he wishes to give to his house, and if he were to always include the terrace in his plans of the house there would be no cause for friction. The garden designer's work is to fill in the framework with beautiful vegetation.

The ground-plans given in the work of terrace gardens are in the main excellent, showing simple and effective beds, and no eccentricities of outline, but the sketches contradict these. The ground-plans of gardens throughout the work are beyond reproach, but seeing that every site of a garden must necessarily need different treatment, and without knowing the natural contours of the ground dealt with, ground-plans do not teach or help much. The illustrations showing garden-houses or summer-housec are good, and are superior to the monstrosities one usually sees in summer-houses where false rusticity is the usual stamp.

The treatment of ornamental water in lakes, ponds, streams and fountains might have been dealt with more fully, and it is comforting to find that the author does not propose to square such a natural-looking lake as that created by the much-maligned Brown at Blenheim. The author's propensity for formality overcomes him even in a natural-looking pond, for in a plan in this article, the islet on the irregular outlined pond has its little formal design. The introduction into gardens of artificial cascades, fountains, etc., in this northern climate requires to be carried out with consummate taste, but nature-like lakelets, or even a Dutch canal, are everywhere desirable in which to grow our recently-acquired hybrid water-lilies.

In his remarks on avenue planting, we are quite in accordance with the author that a stately avenue, considerately located and planted with the right kind of tree, is a beautiful feature in any place, but in the planting of avenues one must be imbued with the bold conception of a Le Nôtre, otherwise an avenue or any symmetrical planting of trees will not be effective.

There are in the book a few charming views of Westmoreland lake scenery, reproduced from photographs; indeed, all the reproduced photographs of natural scenery are admirable, and contrast strongly with the artificiality of the formal garden sketches.

The kitchen-garden, conservatories, hot-houses, etc., are dealt with in the usual way, and call for no comment, beyond that we think the conservatory in Wolverhampton Park, as shown in the illustration, is not an ideal conservatory, being faulty in proportions, and ill-adapted for plant culture, excepting for plants grown only for foliage.

Chapters are devoted to descriptive lists of trees, shrubs, hardy plants, etc., but it is evident that the author's knowledge of these is very superficial, though it is most important in a landscape gardener's education. The lists, the author states, are not intended to be exhaustive, and certainly they cannot be termed selective, when such omissions occur as the Tulip-tree, Catalpa, Liquidambar, Sophora, Viburnum plicatum, Magnolia stellata, Prunus japonica, and many others among trees and shrubs; and such well-known plants as the Japanese Anemone, while no mention is made of Bamboos.

The descriptive notes are often peculiar, thus "Ailanthus glandulosa, generally known as a standard on long clean stems 6 to 8 feet high, pruned to a mop-head, in which form it makes a good tree for planting at stated intervals along a straight walk, it bears lovely flowers, should not be planted in the park or woodland."

Fancy, pruning an Ailanthus into a mop-head! It certainly would not then produce the lovely flowers the author speaks of, but which most people would call inconspicuous. The ruddy clusters of fruit in autumn produced on trees from 40 to 60 feet high, and unpruned are undoubtedly attractive. It is, moreover, a very fine park tree, but is not desirable in a garden on account of the disagreeable odor the tiny green flowers exhale.

The vicious propensity of the author to prune trees into mop-heads is seen throughout his lists, and yet of the Weeping Ash which forms a shady bower without pruning, he says, "It is very funereal in appearance, and can seldom be used with advantage!"

He calls the Wellingtonia the Noah's Ark tree, presumably on account of rigid formal outline. How very inconsistent in one who advocates clipping trees into mop-heads. Again he writes:

"Araucaria imbricata, or monkey-puzzle, is a variety

most unsuitable for garden planting. Its proper place is in an arboricultural museum, or piece of ground devoted to freaks of nature."

Perhaps the author has never seen a flourishing grove of Araucarias, or the stately avenue of them at Bicton. The "arboricultural museum" would presumably be the formal gardens (as shown in his sketches), where the monkey-puzzle would associate with the peacocks, the mop-heads, and other freaks produced by the shears.

Throughout the descriptive lists there are misstatements and errors, and it would be advisable in another edition to revise these, and for some competent person to correct the botanical names.—The Gardeners' Chronicle.

French Demand for Lead and Zinc.—Consul Brittain, of Nantes, under date of May 17, 1900, says:

Inquiry has just been made at this consulate for prices (by the ton) of lead and zinc of all descriptions. American manufacturers of these metals are requested to correspond with M. Albert Brosseau, of No. 4 Rue Cambronne, Nantes, France, and submit prices. Samples of sheet zinc and small blocks of lead may be sent through the mails. Prices should be stated in francs and centimes, and the metric system used in giving weights and measures.

THE ARGUS PHEASANT.

THE gorgeous, many-eyed peacock, the bird of Juno in the mythology of the Greeks, is found in India, from the Himalaya Mountains to Ceylon and Malacca, as well as in Siam and Southwestern China, Java, Sumatra, and Borneo. Among the varieties of pheasants and peacocks, native to Southern Asia, none is perhaps so magnificent in its brilliant plumage as the great Argus pheasant (*Argus giganteus*).

The Argus pheasant has been known to naturalists for over a century; Latham described the bird as early as 1783. But not until comparatively recent times were specimens brought over from Asia and placed in European zoological gardens. The London Zoo in 1870 purchased the first bird. The fine brace in the Hamburg Gardens is pictured in our illustration (taken from Illustrirte Zeitung).

Although, perhaps, not so magnificently colored as the peacock, the bird is none the less noteworthy for the beauty of its plumage. The peacock's characteristics are his tail coverts, which are enormously elongated, erectile, and marked with ocelli or eye-like spots; the neck and breast are of a peculiar iridescent blue with a tinge of green. The Argus pheasant, on the other hand, is remarkable chiefly for its wing-feathers, which are longer and broader than in any other bird. These wing-feathers are delicately tinged with colors that vary from brown, and gray to olive-green, and are beautifully ocellated with metallic iridescent spots or "eyes," arranged in rows. The tail-feathers are extraordinarily developed, so extraordinarily in fact, that, although the common species has a body only about as long as that of a common barnyard-hen, the total length of the pheasant is frequently six feet. The female is a plain bird, lacking the extraordinary development of the wing and tail feathers.

The Argus pheasant inhabits the dense jungles of Southern Tennasserim and Sumatra. Its great ornamental feathers are a hindrance to long flight, for which reason it usually walks or runs on the ground, rarely leaving those places which by reason of their foliage and vegetation most nearly resemble its own beautiful dress. Naturalists and explorers have, therefore, seldom had an opportunity of observing the bird. An old Malay who for twenty years trapped wild birds, told Wallace that he had never been able to shoot or even to see a wild Argus pheasant.

At pairing-time the male usually plays before the female upon a bit of ground which he has carefully cleaned. Every feather is raised, so that the outspread wings almost form a wheel, the spokes of which are the series of splendid ocelli or eyes. In order not to mar the beautiful picture which he presents, the Argus hides

THE ARGUS PHEASANT OF SOUTHERN ASIA.

his ugly, bald head behind one wing. But now and then he peers curiously behind his wing to see what impression his charms have made on the hen. When the male is killed or caught, the female immediately returns with another male to the selfsame spot upon which her former partner had wooed her.

[Continued from SUPPLEMENT, No. 1277, page 20467.]

THE MEANS OF DEFENSE OF ANIMALS.—IV.*

PROTECTION AGAINST LIVING ANIMALS.

APPARENTLY the only author who, in very recent years, has treated of the means of defense of animals is the French professor, L. Cuénot. He delivered an address on this subject at the annual meeting of the Zoological Society of France, February 25, 1898. The scope of his remarks, however, is much narrower than that of the present course of lectures, since he confines himself to that special division of the subject which we are about to consider to-night. Doubtless the expression, "means of defense of animals," would suggest to most persons defense against living foes. We shall avail ourselves of Prof. Cuénot's paper, and then subsequently deal with some aspects of the subject on which he is silent. The first ten of the following headings are those under which he has grouped his facts, although we shall not confine ourselves to translating his statements.

1. Flight and Autotomy.—The ability to escape by flight from living enemies is, in a number of cases, enhanced by the power of self-amputation of limbs and other members. It is this power which is also known as autotomy. Familiar illustrations are seen in the legs of grasshoppers, crabs, and related articulates, in the tails of lizards, etc. This would be an expensive means of defense if no replacement of lost parts occurred, since the resulting lack of locomotion would be likely to bring death from inability to obtain food. In most animals, however, where autotomy occurs, the ability to regenerate the amputated limb or tail also exists. A notable exception is that of the large jumping legs of the grasshoppers, which, once lost, are not renewed (Bordage, 1899), and if death does not always result from excessive bleeding, it seems quite likely that the mutilated insect may take no part in the reproduction of the species. Much attention has been paid within recent years to the phenomena of regeneration, and a widespread opinion exists that in each animal the power of regeneration is best developed in those parts of its body which are most exposed to injury and which are, so to speak, autotomic. Prof. T. H. Morgan's observations and experiments on the hermit crabs lead him, on the contrary, to the belief that in these animals "there is no relation between the regeneration of the leg and its liability to injury." This appears from the fact that all the limbs are capable of renewal, although it is only in the first three pairs of walking legs that mutilations are found under natural conditions. This view is further strengthened by observations of M. Bordage on locustids (long-horned grasshoppers) which had lost their jumping legs previous to attaining the adult condition: "I have been able to note with regard to larvæ kept in captivity how difficult the moults become after the loss of jumping legs. Difficulties presented themselves especially at the last moult, when the Orthopteron must free his wings from their covering. His big hind legs would have allowed him to brace himself up to his work more effectively, giving him a valuable support at the time when he had to make his laborious efforts to free himself from his chitinous envelope. Almost all die before having rid themselves of this wrapper. Among the rare survivors, with one or two exceptions, I have seen only completely disabled insects, with wings all crumpled, and sometimes even atrophied, creeping along with difficulty."

With regard to the nature of the autotomic act itself, it may be mentioned that it is not voluntary, but involuntary and reflex, due to pressure on the limb possessing this power.

2. Armor, Spines.—After citing the scales of the armadillo, the carapace and plastron of the turtles, the thick coat of many insects, the shells of mollusks (occupied by the creatures which have formed them, or by their subsequent tenants, the hermit-crabs), the cases of silk, covered over with pebbles or fragments of wood, of the book dwelling caddice worms, and the bag made out of its own excrement, which the beetle-grub Cryptocephalus wears about its body as a protection.

M. Cuénot points out that such beetles as the lady-birds escape carnivorous insects more by the rounded form and polished surface of their body, than by the thickness of their body-wall. For the jaws of their enemies slide over them without obtaining any firm hold for the bite which would pierce a much more heavily armored insect. A similarly defensive form is assumed by some armadillos and scaly ant-eaters, which, when attacked, roll themselves into a ball. Brehm, in his "Thierleben," has mentioned cases where the South American three-banded armadillo thus escapes the fury of dogs, and gives Desmarchais as the original authority for the statement that the long-tailed pangolin of Africa protects itself from leopards in this way. It would be interesting to know whether anyone has observed actual instances of this same habit affording sufficient protection to our common pill-bugs against some of their foes.

Spines distributed over the entire surface of the body, or limited to certain areas, afford a very common means of defense. Thus, among mammals, the porcupines and the hedgehogs, the Uromastix lizards among reptiles, the entire body of the blow-fish and the dorsal fins of other members of this class, the shells of many Murex snails, various crustaceans allied to the lobsters (Palinurus, Polycheles), spiders such as Gasteracanthus, sea-urchins, and brittle-stars, are protected in this manner. The efficiency of such spines is increased when they are barbed, as on the tail of the sting-rays, or movable, as in many instances named above, or have associated with them glands secreting an irritating or poisonous liquid, as in a number of fishes and of sea-urchins.

To this same class of defenses belong all those afforded by horns, teeth, tusks, claws, hoofs, stings, jaws, etc., all operating in a purely mechanical way.

3. Electrical defenses appear to be confined to three groups of fishes, the torpedoes of warm and temperate seas, the electric eels (Gymnotus) of the fresh waters of tropical South America, and the sheath-fish (Malapterurus), an ally of the cat-fishes, found in various African rivers. The electric discharge is occasioned by contact with the body of the fish, but is under voluntary control of the latter as regards its time and strength. The organs by which the current is produced are transformed muscles.

4. Chemical defenses embrace a great variety of secretions from adhesive substances, which act simply by reason of their physical properties, like mucus, to the most virulent poisons, as well as caustics and fluids having disagreeable tastes or odors.

M. Cuénot relates a personal observation of defense by means of an adhesive secretion. One of the sea-cucumbers of the English Channel, attacked by a crab, ejected from its cloaca a number of white, sticky, thread-like streams, which, coming in contact with the crab's limbs, became so entangled therewith that the crab retired from the field. Other observers testify to the successful employment of the same defense against fishes and lobsters.

Under this class of defenses it has been the custom to place the discharges from the vent of the so-called Bombardier beetles and their allies. M. Cuénot relates that upon offering some of these Carabidæ to frogs, lizards, and a woodpecker, they were immediately rejected, intact, the assailant showing all the signs of the deepest disgust. It has usually been considered that the discharged substance is the malodorous secretion of special glands. The more recent studies of Fr. Dierckx, S.J. (1899), offer a different explanation. The pair of pygidial glands emptying into the hind part of the intestine, secrete a colorless liquid, having a weak but characteristic odor, which, when expelled from its reservoir, volatilizes with an explosive sound. This gaseous jet drives the creature's excrement through pores, whose horny edges are guarded with hairs, whereby the fæcal matter is pulverized. It is this pulverized excrement which excites the disgust of the enemy, and which also gives the yellow stain noticed by many observers. The allied water beetles known as Dytiscidæ also discharge their fæces, often with force, as a means of defense, but although they too possess pygidial glands, their secretion appears to take no part in the expulsion. The odor of hydrogen sulphide which sometimes accompanies this act results from the decomposition of the food.

The chemical composition of the substances which impart the protective value to the secretions of animals is very various. Formic acid is the irritant operating as the result of the stings of ants and bees, and in the secretion of the prothoracic gland of the caterpillar Dicranura vinula; salicylic acid in the liquid escaping from the beetle larva Melasoma; prussic acid passes out through the pores (foramina repugnatoria) of certain millipedes; free iodine occurs in the extremely corrosive liquid ejected by the ant-hill-inhabiting beetle Paussus. The poisonous principles of snake-venom are globulins, albumoses and peptones; of the skin-secretions of toads, methylcarbylamin, $C \equiv N - CH_3$, and isocyanacetic acid, $C \equiv N - CH_2 COOH$; of the milk-like secretion of the skin of the crested Triton, isocyanpropionic acid. Bufidin, or phrynin, an alkaloid-like substance isolated from the skin of toads, when taken into the stomach gives the same symptoms as those of digitalin poisoning. Samandarin, or salamandarin, an alkaloid from the acid cutaneous secretion of Salamandra maculosa, like bufidin is irritating to mucous membrane, but taken into the stomach acts like strychnine.

While most of the poisons which play a defensive rôle are ejected by means of definite glands, a number of animals whose blood contains toxic principles, present the phenomena of reflex bleeding. An earlier (1896) memoir of M. Cuénot summarizes the known facts as follows: Certain lady-birds, vesicating beetles and grasshoppers, when disturbed, "feign death," and exude drops of blood through the mouth, the femoro-tibial articulations of the legs, or the point of attachment of the front wings. In all these insects the blood contains toxic, caustic or repulsive products in solution, the best known of which is cantharidine (blister beetles). This exuded blood is a very efficacious means of defense against lizards and batrachians. Its exudation can be excited by touching or irritating the animal, by weak chloroform and by other agents. The blood within the body cavity is strongly compressed by the contraction of the abdomen, and breaks through the least resistant portions of the cuticle.

The horned toads of the Western States are known to eject blood from their eyes with force when irritated. Such blood has, at times, been "shot" into human eyes, with the consequent production of some pain, but observations as to its protective value against other animals seem to be lacking. Not all individuals of this genus of lizards (for such they really are) appear to possess this habit.

5. The habit of feigning death when disturbed is met with in many animals, such as the spring-beetles (Elateridæ), small land-snails, the opossum, the red fox, and in many of those previously mentioned as rolling themselves into a ball when attacked. In the smaller species which practise this ruse (which is likewise regarded by Cuénot as the result of a reflex act), two protective advantages appear to result; enemies which, like lizards, batrachians, dragonfly-larvæ, seize only moving prey, are foiled; or, falling to the ground or the water-bottom, the deceiver is lost to view among the herbage or the débris.

6. The antithesis of the habit just mentioned is that of assuming a frightful, terrifying or grotesque appearance, due to the erection of the hair, feathers, folds of skin, or other superficial appendages, or by inflating the body. The fourth chapter of Darwin's "Expressions of the Emotions in Man and Animals" contains a considerable number of observations on this subject, and there also it is suggested "the threatening gestures made by many snakes—their hissing—the rattling of the rattlesnake, and of the tail of the Trigonocephalus—the grating of the scales of the Echis, and the dilatation of the hood of the Cobra, all subserve the same end, namely, to make them appear terrible to their enemies."

7. Commensalism.—When two species of animals habitually live together, neither at the expense of the other, but deriving some advantage from the association, such are said to be commensals or messmates. Frequently, the advantage which one of the commensals obtains is protection by means of the defenses of the other. Thus, many small fishes, apparently devoid of any special defensive means of their own, are found living within the digestive cavity of sea-anemones and medusæ, which are amply provided with stinging cells (nematocysts). Lieutenant C. C. de Crespigny wrote (1869) of the sea-anemone Actinia crassicornis: "It is found at Labrian in various habitats—sometimes domiciled in rows along the horizontal fissures of sandstone rocks (the positions being chosen so that at low water they may be just awash), in other cases surrounding and covering a mass of exposed dead madrepore (coral). It is also found attached to rocks or dead coral some inches under the surface of the sand, and from this vantage ground protruding or withdrawing its tentacula at pleasure, so that when they are withdrawn the animal is no longer visible. On a calm evening, when the tide is out, one may observe with advantage the sympathy which appears to exist between this animal and the little fish called Premnas biaculeatus. The Actinia is in a state of quiescence, allowing its tentacula to float and move about freely in obedience to the impulse of each ripple of the water, they being now supple, pointed at the extremities, and gravitating downward. A Premnas now passes over the Anemone, and immediately the tentacula become erect and diverge as if galvanized, while their extremities become clubby and phosphorescent. The fish hovers over it, gently rubbing the tentacula with his pectoral fins, and so will remain for some time. The hand-net is passed quietly down under the Anemone, and the alarmed fish, instead of swimming away, dives into the body of its friend, the tentacles closing over it, and thus burying it in a living tomb. The hand of the captor now disturbs the fish in its hidden retreat, and upon its again rushing forth from its hiding-place the net is drawn to the surface of the water and the little fellow captured . . . In captivity I have known an Anemone live in perfect harmony with a Premnas for nearly a year. . . . On the other hand, I have known a fish to live in a tub for a long time without the society of its complementary Anemone."

Such protection is, however, purchased too dearly at times. Coming nearer home, Prof. Alexander Agassiz says of the jelly-fish Dactylometra quinquecirra, which he found at Naushon, on the Massachusetts coast, "This Pelagia is always accompanied by a species of Clupeoid, found in the folds of the fringes of the actinostome (mouth). Moving along with the jelly-fish, which, when they are pushed off accidentally, rush back to their place of shelter. From twenty to thirty specimens have been found swimming in the fringes of the actinostome. It is strange that the fish should go there for shelter, for every once in a while one of them pays the penalty by being swallowed, without this disturbing the others in the least; they in their turn find food in the lobes of the actinostome, and even eat the folds themselves, until their turn comes to be used as food. I have seen in this way three fishes eaten during the course of as many days." It may be that in this instance the food to be obtained is the attraction to the fish, rather than the protection afforded by the surrounding tentacles of the jelly-fish, but that the protection should result incidentally renders the habit on the part of the fish none the less a means of defense.

Another illustration of the protection which results from commensalism is to be found in the myrmecophilous and termitophilous animals. These terms indicate association with ants and termites respectively. Father Wasmann, of Exaeten, near Roermond, Holland, the chief authority on this subject, published, in 1894, a list of the Arthropods (known to have such habits). He enumerates 1,078 species of beetles, 45 Hymenoptera, 22 Lepidoptera (chiefly caterpillars), 20 Diptera, 10 Orthoptera (crickets, etc.), 75 Rhynchota (bugs, aphids), 21 Thysanura (spring-tails, silver fish), 29 Spiders, 34 Mites, 9 Crustaceans. Since the ants or the termites, vigorously assail intruders, the "guests," living within their nests, receive protection as well as hospitality.

8. Special Defensive Individuals exist in some species of animals. Such are the so-called soldiers of ant-hills and termite ("white ant") colonies. In the species in which such soldiers are distinctly developed, they possess larger heads and larger mandibles than their brethren, the increased size of the head resulting from the greater mass of muscles required to move the jaws. The excessive development of these parts often prevents the soldiers of termites from gnawing wood, a source of food much in use by other individuals of the species. Mr. J. Beaumont observed that when portions of a gallery, made by Eutermes on the Isthmus of Panama, were destroyed, the soldiers would form a double line of defense, while the workers carried pellets to and fro between the files of guards, and, so protected, repaired the destruction. In this species it was the workers who did the actual fighting with other species, but in some of the European termites Grassi and Sandias saw both soldiers and workers engaged in slaughtering their foes. The specialization of soldiers is further indicated by the arrested development of their reproductive organs; the soldiers of ants are transformed females, but those of termites transformed individuals of both sexes.

So also have certain much modified members of fixed, branched, colonial animals, the sea mosses (Bryozoa), been regarded as special defensive individuals (so-called avicularia and vibracularia).

9. Homochromism.—Under this term, signifying, literally, the state of being similarly colored, Prof. Cuénot has grouped those cases which are considered by other writers as instances of protective coloration, protective resemblance, or procryptic colors (Poulton). The defense here afforded results from concealment effected by resemblance in color, shape or outline to inanimate objects. Numerous illustrations of such resemblances are known to every observer of nature, but while such likenesses frequently deceive the human species, it is not yet clearly and definitely ascertained whether carnivorous animals are equally duped. Many animals seem to depend far more on the movements made by their intended prey, than on its colors, when seeking to discover its presence, an apparent fact unfavorable to the view which regards protection by color as an important means of defense. The whole subject is very extensive. Much has been written upon it and

* A series of lectures delivered January and February, 1900, at the Academy of Natural Sciences, of Philadelphia, by Philip P. Calvert, Ph.D., of the University of Pennsylvania. Copyrighted, 1900, by Philip P. Calvert. Revised by the author.

two recent English books, by Prof. Poulton ("The Colors of Animals," International Scientific Series, 1890) and by Mr. Beddard ("Animal Coloration," 1892), deal with many aspects of it. What is wanting, however, is more actual observation and experiment to test the protective value of such resemblances.

10. Mimicry.—When one species is externally a more or less exact copy of another species with which it is not related by descent, a case of mimicry exists. If the species copied possess some qualities which render it obnoxious or distasteful to its enemies, so that they learn to avoid it as food, then the very resemblance possessed by the mimicking species is a defense—whence protective mimicry. The value of the protection thus obtained by the mimic depends on the enemy possessing sufficient memory and power of reflection to associate the external appearance and the obnoxious qualities. Such a degree of mental endowment is usually, but perhaps incorrectly, ascribed only to birds and mammals. Cases of mimicry are known chiefly from insects, and especially butterflies, and, to a less degree, among vertebrates. But here, as with protective resemblance, the actual evidence for the protection resulting from mimicry is not very great.

11. Warning Colors.—Prof. Cuénot has not referred to another class of color defenses, neither homochromic nor mimetic necessarily, but often known as warning colors (sematic and aposematic colors of Poulton). In general, such colors are bright and conspicuous, and are believed to be protective in that they are associated with disagreeable qualities possessed by the animal itself. The working effects, so far as enemies are concerned, are the same as in protective mimicry.

With the view of exhibiting the character of the evidence now at hand relating to the protective value of color, the following summaries of recent experiments are given. The first series to be described has been quoted by several writers, although not always have the same conclusions been drawn.

Experiments on the defenses of nudibranch (shell-less) mollusks against fishes were made by Prof. Herdman, at Liverpool. They consisted in dropping various species of the former, half an inch to two inches in length, into tanks wherein various fishes had been living for many months. On the days when experiments were made the fishes were not fed as usual. As a test of their appetites, however, at the beginning and at the end of each day's experiments, a few cockles or mussels, the ordinary food of these fishes, were thrown in and were caught and bolted in the usual manner. The mollusks used were species occurring abundantly on the coast near Liverpool. The fishes were such as are likewise found in the same situations. The conclusions which were reached by the experimenter and his associates were that "Eolis is a most distasteful form and has conspicuous colors of a warning nature. Ancula is also distasteful and is conspicuously colored. Doris is less distasteful and is still protectively colored; while Dendronotus, which we believe to be edible, is very effectually concealed among the sea-weeds it lives on by its large branched cerata and red brown colors." They also observed that Ancula "was present on the rocks at Hilbre Island in great abundance, in very prominent and exposed situations, and that its coloring was not protective but rendered it conspicuous." The conclusion that some of these mollusks were distasteful was based on observations that such forms were taken into fishes' mouths and quickly rejected, or were not taken in after examination at close quarters. Since some individual mollusk was in some cases seized and rejected by as many as ten fish in succession, or by the same fish nine times in succession, the mangling which the mollusk received was very serious, even though it was finally left by the fish. Eolis has cerata (finger-like processes) which are believed to sting the lips of fish; codfish did not take it into the mouth, although coming close to it and touching it with the snout. Other fish seized Eolis, but immediately rejected it, sometimes in pieces, so that here again the means of defense did not avail to save life. The experimenters themselves point out a disturbing factor in their results. It was that the fishes had long been accustomed to have their food dropped in from above, so that when anything, such as a bit of white shell, was thrown in, a rush was at once made for the falling object. When Ancula was placed on a stone lowered quietly into the water it crawled over the tank without being touched by the fish. Further, a marked difference existed between the manner in which the fish took a cockle and an Ancula, both dropped from above, the former being swallowed at once, the latter, if seized at all, only partly taken into the mouth.

Some of the most recent experiments on the theory of warning colors and mimicry have been made in Calcutta by Mr. Frank Finn, deputy superintendent of the Indian Museum. They were definitely undertaken in "the hope of supplying some of that experimental proof of the unpalatibility of such species" of butterflies as were supposed to be "warningly colored." They consisted in offering butterflies to insectivorous birds in confinement and also at liberty, to lizards, a tree-shrew (Tupaia) and a bullfrog. He concluded that for the lizards, their behavior "certainly does not appear to afford support to the belief that the butterflies, at any rate, usually considered nauseous, are distasteful to them." For the tree-shrew, "it is obvious that this animal had a very strong objection to the 'protected' Danainæ and Papilio aristolochiæ, as it so constantly refused them, and that, in the case of the former, absolutely." As regards the birds, he concludes: "(1.) That there is a general appetite for butterflies among insectivorous birds, even though they are rarely seen when wild to attack them. (2.) That many, probably most, species dislike, if not intensely, at any rate in comparison with other butterflies, the 'warningly-colored Danainæ, Acraea violæ, Delias eucharis, and Papilio aristolochiæ; of these the last being the most distasteful, and the Danainæ the least so. (3.) That the mimics of these are at any rate relatively palatable, and that the mimicry is commonly effectual under natural conditions. (4.) That each bird has to separately acquire its experience, and well remembers what it has learned. That, therefore, on the whole, the theory of Wallace and Bates is supported by the facts detailed in this and my former paper, so far as they deal with birds (and with the one mammal used). Prof. Poulton's suggestion that animals may be forced by hunger to eat unpalatable forms is also more than confirmed, as the unpalatable forms were commonly eaten without the stimulus of actual hunger—generally, also, I may add, without signs of dislike."

The admission contained in the last sentence seems to indicate that, after all, protection by color is not very great.

12. An important means of defense is that which results from the adoption of the social habit of life by members of one and the same species, without the development of special castes of individuals whose chief function is that of defense of their fellows.

This aspect of life has been made the subject of an essay by the Russian Prince Kropotkin, under the title "Mutual Aid among Animals." He has brought together records of a very considerable number of observations relating chiefly to birds and mammals which illustrate his contention that "mutual aid is as much a law of animal life as mutual struggle, but that as a factor of evolution it most probably has a far greater importance, inasmuch as it favors the development of such habits and characters as insure the maintenance and further development of the species together with the greatest amount of welfare and enjoyment of life for the individual, with the least waste of energy." The assemblage of great numbers of individuals of the same species which unite to repel the attacks of foes individually larger, or the posting of sentinels who give warning of the approach of danger, are phenomena which have been observed in bees, pelicans, sparrows, gulls, cranes, parrots, ducks, polar foxes, marmots, prairie-dogs, wild horses, zebras, deer, elephants, hamadryad baboons, and, it is unnecessary to add, man.

13. Moulting is a wide-spread phenomena among arthropods. Crustaceans, spiders and insects frequently cast their shells or skins as they increase in size. Some recent observations of the French naturalist, Kunckel d'Herculais, suggest that this process, in addition to permitting rapid growth and to acting as a method of

DISCHIDIA RAFFLESIANA.

W, leaf converted into an urn, into which enters a root.

excretion, may also be of considerable importance as a means of defense.

It is known that fungi or their spores have been found upon insects in various parts of the world. This fact has been made the basis of an attempt to inoculate injurious insects with fungous diseases in order to destroy them. In applying this remedy to the devastating locusts of Algeria (Schistocerca peregrina) d'Herculais found that the moults of these insects, occurring on an average every eight days, were decided obstacles to the fixation of the spores of lachnidiurn acridiorum on the surface of the locusts' bodies. When these spores develop upon adult locusts, which no longer moult, the mycelia (threads growing from the spores) enter the spiracles, clog up the tracheæ and so produce asphyxia in the young locusts; however, the repeated moults affect not only the external cuticle, but also the internal lining of the tracheæ. The casting off of this lining is, self-evidently, likely to remove the fungous growth. Further, the process of moulting involves the chitinous lining of the intestines. After each moult, pigmentary materials mingled with excreta are expelled by the animal. Within these pigment granules, parasitic gregarines are found. Such gregarines are found in abundance living in the intestine of the destructive argentine locust (Schistocerca paranensis) between moults, but they diminish in number after each moult. So, concludes d'Herculais, we can understand the resistance which insects (may we not say Arthropods ?), in some conditions of normal life, can offer to the contamination or to the disorganizing action of animal or vegetable parasites.

14. It would be interesting to know how far the habit of cleansing the body is a means of defense against living foes to those animals which perform such an operation. Among insects this performance frequently occurs, and has probably been witnessed by everyone in the common house-fly. Quite complicated structures exist on the legs of bees, ants and other hymenoptera for the removel of dust from the antennæ. Many insects brush off the dust which accumulates on their eyes, and this is doubtless to enable them to see more clearly. So, also, the cleansing of the antennæ is, most likely, for the purpose of freeing their delicate sensory organs from dust and dirt. The hind legs are often employed to rub off the abdomen and the wings; and M. Coupin states that in so doing they dislodge mites which not infrequently infest these parts. Since these mites are external parasites, cleansing would in this case be unquestionably a means of defense against enemies. Similarly, in the case of man, cleansing the body is an important means of defense; and even at the present time, physicians occasionally meet with individuals who, owing to filthy habits, have been seriously afflicted with external parasitic insects. At the same time it must be pointed out that many parasitic insects, after having used their legs to clean various parts of their bodies, subsequently clean the legs by drawing them through the mouth. This recalls the cleansing of their bodies by many mammals, such as dogs, cats, cows and horses, by licking with the tongue. Since this act is known to be the means of introducing various internal parasites into the body, such as certain tapeworms in the dog, and bot-flies in the horse and perhaps, also, in oxen, it is likely that it may have the same result in insects. This kind of cleansing is therefore quite as dangerous as beneficial.

15. Quite special and peculiar to man is the protection against parasites and bacterial diseases which result from his cooking his food. Thus it is noted that the broad tapeworm (Bothriocephalus latus) "occurs in man endemically in the Eastern Baltic provinces, certain parts of Switzerland, generally throughout Russia (especially near Kasan), in North America, and commonly in Japan: that is, in districts where the population partake largely of pike or other fish in a raw or partially cooked state." Protection against disease by cooking, for example, boiling even water, is fast becoming appreciated. Its efficiency lies in killing minute living enemies, bacteria. That cooking of food is a protection—a means of defense—has been recognized only within quite recent years, although the practice for other purposes is many centuries old. The protection thus derived has been incidentally acquired as a result of habits having originally quiet different objects in view.

Bacterial diseases are quite as truly illustrations of the preying and feeding of one living thing upon another, as when a lion seizes and devours an antelope. The antelope may possess horns with which to defend itself against the lion, but when bacterial diseases attack animals, the only defense possessed by the latter is that offered by their leucocytes, or white blood corpuscles, which devour the bacteria. That this is too often an inadequate defense is shown not only by the occurrence of epidemics among animals attended with high mortality, but also by the direct observations of Cuénot (1894), who states that phagocytosis (the devouring of one cell—a bacterium—by another cell, a white blood corpuscle) plays but a very slight rôle in the destruction of internal parasites of arthropods, with the exception of encysted gregarines.

Only man, with his cooked food and other hygienic precautions which the painful experience of many ages has slowly taught him, seems to be in better position to resist the smallest and yet most dangerous of all living enemies.

THE MODIFIED LENSES OF DISCHIDIA.

THE Dischidiæ are epiphytal Asclepiads of the extreme East, having twining stems and branches that wind around trees. They are especially remarkable through the possession of organs in the form of urns that hang from the twining branches and into which enter adventitious roots that emanate from the peduncle that supports them. The resemblance of these urns, which are often filled with rainwater, to the galls produced upon the leaves of various trees by lice of the genus Pempligus, is such that a number of the first observers of these plants considered them as abnormal organs due to the puncture of parasitic insects.

The morphological nature of these curious organs has been perfectly elucidated by the researches of Treub, who has found that they are modified leaves. The normal leaves of the Dischidiæ are orbicular, thick, fleshy and opposite. The urns are nothing but the limb of leaves of which the lower surface corresponds to the internal face of the urn. The petiole of this abnormal leaf is thicker than that of the normal leaves. The mode of formation of such organs may be understood by imagining the limb of a normal leaf to have been bent back toward the earth and then turned upright and its edges brought together. In reality, a change of growth manifests itself in the young urn in the way of formation.

The growth localizes itself nearly upon the median part, so as to cause it to assume the form of a hood, of which the opening is at first turned downward, and is afterward, progressively, more or less turned upward.

The Dischidiæ have opposite leaves, but the normal leaf opposite the urn aborts as a general thing. When the young urn affects the form of an elongated bag, a few adventive roots are seen to make their appearance upon this petiole. Those of the roots that grow near the mouth of the urn enter its interior. An adult urn ordinarily contains one or two long adventive roots provided with a well developed system of rootlets. The internal surface of the urn is purple, while the external is grayish or of a glaucous green, as is also the surface of the stalks and leaves.

The direction of the urns is variable and worthy of arresting the attention. The majority hang vertically with the mouth upward; but there are also some that are horizontal and others that are upright and that turn their closed extremity upward; that is to say, that preserve the position which they had at the time of their formation.

The urns of the Dischidiæ are often inhabited by ants. So Beccari asked himself whether it is not an irritation produced by insects (perhaps ants) that has determined the abnormal evolution of leaves converted into urns. Such distortion, at first accidental, may have become hereditary through the indefinite continuation of the phenomenon. That the prime cause of this abnormal evolution may have been parasitism is a sustainable hypothesis; but in the present state of

things, nothing can now permit of attributing any role whatever, in the formation of the urns, to the stings of insects. However it may be with the role of ants in the production of urns, it is permissible to ask whether biological relations do not exist between them and the Dischidiæ, the urns of which they frequently inhabit.

Other insects but rarely enter the urns. The ants met with therein are always very lively and generally in very large numbers. The urns become genuine formicaries that shelter hundreds of individuals and many larvæ. The ants leave the urns with the same facility as that with which they enter them, since the latter present no arrangement apt to retain the insects that find their way into them. On the contrary, the adventive roots that traverse them from the petiole to the bottom form with their numerous radicles a sort of ladder leading to the exterior. When an urn that contains ants is pressed, the insects are seen to make their exit in large numbers, carrying their larvæ and nymphs. It is well to note that the Dischidiæ, according to the station, offer an asylum to ants or vegetate independently of all relations to them, and exhibit urns that are absolutely abnormal. Our engraving is from the Revue Encyclopédique Larousse.

THE CREST OF THE PALACE OF ELECTRICITY.

THE Palace of Electricity of the Exposition of 1900 is a strange structure. It is built in the air, or, at least, it puts itself in evidence externally only through an aerial decoration. There is no façade, no entrance-porch, nor any basement. It is a crest, and nothing more, rising above and enveloping the Chateau d'Eau—that huge decoration of staff and cement that seems to be supported by an invisible metallic wall.

A diadem, an open fan and the outspread tail of a peacock are some of the comparisons that have been made with regard to the Palace of Electricity. Some justification is found in all of these when M. Henard's work is observed from some little distance. When it is examined close by and in detail, however, it is perceived that its conception, apparently fantastic, is full of logic. The space allotted to the Palace of Electricity was a narrow strip of ground hemmed in on every side. It was necessary that the edifice should be seen above another structure, that it should itself conceal the old Gallery of Machines, so as to give the Champ de Mars a new background, and that its appearance should show its structure and purpose. In order to satisfy the first two requisites, a very high roof was necessary · and the architect satisfied the third by adopting an ornamentation which faithfully shows the line of the roofing, and by giving as a motive to such ornamentation the glorification of electricity.

In the daytime, the crest of repoussé zinc, with openwork recalling that of lace, leads the eye toward the central and culminating point. Here, at a height of 196·8 feet, upon a platform that crowns the roof, is seen a naked figure by the sculptor Marqueste. It is the Fairy of Electricity standing upon a sort of car drawn by a pegasus and a dragon. Its stature is 21·3 feet. Behind the group, a huge star extends its gilded points in every direction.

During the evenings of fête-days, the crest is beautifully illuminated, and electricity furnishes the light and fire for the celebration of her own apotheosis.

It was but a few Sundays ago that the Palace of Electricity was ablaze for the first time. Eight days previous a general "rehearsal," so to speak, had taken place. It was the first and sole rehearsal, because of the small number of dynamos that were in a condition to operate. Nevertheless, although the electricity was generated for the first time at the moment of lighting, success was obtained at the very start, just the same as if there had been time beforehand to carry on a series of detailed experiments. This result reflects the greatest honor upon M. Henri Beau, the illuminator of the Henard Palace, as well as upon his engineers.

Electricity as a source of light has a serious rival within the enclosure of the Exposition. This is not acetylene, as might have been expected a few years ago, but simply gas, which has never admitted itself as vanquished. The current phase of the contest between these two rivals is full of interest and is provocative of the happiest consequences. Gas has improved, multiplied and amplified its incandescent burners, has installed itself at the Trocadero and on the Champ de Mars, and, since the first few days following the inauguration, has been diffusing floods of dazzling light. It was able to set gas (which was not ready) at defiance, and to challenge it to produce a more beautiful light. In fact, it seems as if this year electricity, as a source of light, were paling before gas. But, held in check at one point, it has, it appears, sought another field of combat. It has left to gas the task of lighting, while it has taken upon itself the mission of illuminating.

In former times, illumination by electric lamps copied after illumination by gas. The incandescent bulbs were arranged in rows that simply delineated the lines of buildings, and the rays of light lacked the scintillation of gas. It was cold and monotonous.

An endeavor was, therefore, made to obtain new effects by utilizing the qualities inherent to incandescent lamps—suddenness and simultaneousness of ignition and capability of being placed in any position and of receiving various colors. It was on these lines that the illumination of the Palace of Electricity was conceived. When the crest is illuminated, it forms, properly speaking, a gigantic piece of fireworks. For the "set pieces," complicated frames were constructed, and then, with small lamps placed very close together, here and there, ships, symbolic groups and fanciful figures were outlined. When the current is turned on, the contours of the motives gradually appear in lines of fire, change color, and then disappear. This is not all. Glass windows are inserted in this zinc mounting of the crest, and eleven projectors placed in the rear throw a light through them and cause a play of all the colors of the rainbow. When all the five thousand seven hundred bulbs of the crest are shining at the same time, this effect blends with the general radiation. But if the incandescent lamps be extinguished, and the projectors are allowed to operate alone, a soft light shows all the glazed apertures, while an arc that seems to be phosphorescent, and that stands out from the dark background formed by the sky, might cause a person to think that he was witnessing a natural optical phenomenon.

The star at the summit completes the luminous decoration. Nothing would have been easier than to place behind the Marqueste's group a flat star of which the points would have been sharply outlined by rows of lamps. But an endeavor was made to do something else, and so there was constructed a thirty-eight pointed star, forty-nine feet in diameter, having the form of an icosahedron.

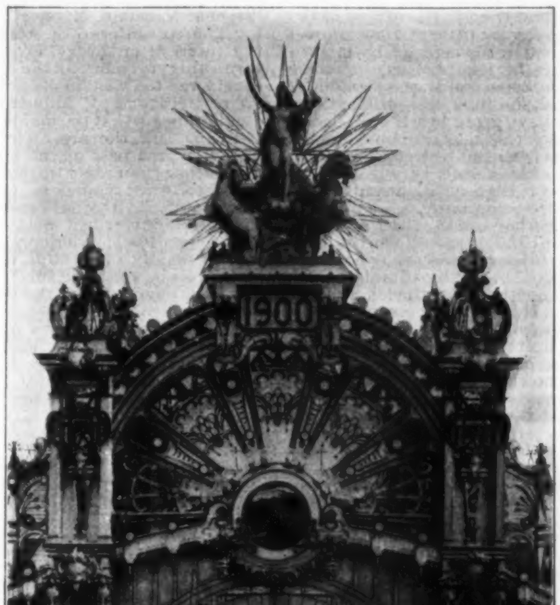
MOUNTING OF THE STAR THAT CROWNS THE PALACE OF ELECTRICITY.

The mounting of this star, which is formed of gilded iron tubes and has a total weight of six and one-half tons, was effected without the use of any scaffolding. All the pieces that compose it were so calculated that they could be accurately adjusted to each other, in space, up to the extremity of the points, and without the use of any supports.

The latticed panels are ornamented with flint-glass flowers, the object of which in the illumination is to catch the light projected by six powerful arc lamps placed in the center of the star.

In addition to the five thousand seven hundred incandescent lamps (one hundred of which are used for tracing the date of 1900) and the seventeen-arc ones, the illumination of the background decoration of the Champ de Mars comprises one thousand five hundred lamps distributed in the large arch of the Chateau d'Eau. The illumination of the cascades and jets of water, which was intrusted to other electricians, was retarded for a time on account of a fire that occurred

in May. The wonderful bouquet of luminous flowers that visitors have an opportunity of admiring on the evenings of Sunday and fête-days is supplied by cables of wide section connected with the general switchboard in the basement. In conclusion, it may be stated that the illumination of the crest of the Palace



CROWNING MOTIVE OF THE PALACE OF ELECTRICITY.

of Electricity absorbs a power of 390 kilowatts, that is to say, the equivalent of 530 horse power.

For the foregoing particulars and illustrations, we are indebted to L'Illustration.

COTTON SUPPLIES.

By JOHN A. BANISTER.*

To sustain the hope of adequately dealing in a single paper with the vast subject of cotton supplies, one should possess, in addition to almost inexhaustible information, a long lifetime of experience, and infinite assurance. In all these respects I can only deprecate my deficiencies, but since, in regard to so great a matter, the wisest of us must necessarily be and continue learners, it is my hope that should I in any respect fall short of your expectation, the will to serve you may be taken for the deed. I shall make no statement which I have not been at the greatest pains to verify, but touching, as I shall necessarily touch, upon points upon which many of you are recognized experts, I shall myself be only too glad, in the subsequent discussion, in which I hope many of you will participate, to learn from any who will be able to throw light upon this extremely important and interesting subject.

In all industrial matters there is a tendency to dissociate what are called the practical needs of the period, or of the moment, from the more picturesque elements, which the work of nature and the labor of man invariably supply. The British mind, excelling in power of concentration and intensiveness, is not readily attracted to wider spheres of observation than the exigencies of a particular trade or craft, or a particular section thereof, may happen to demand. It is true that we gain thereby, inasmuch as our energies are not liable to be dissipated in visionary speculation, but the keynote of the present age is breadth, expansion, development, unexampled in the history of the world, and, as a nation, the first necessity for us is to avoid even the semblance of lagging behind, or resting upon past triumphs.

In the "spacious days of Great Elizabeth" civilization, which comprises and is also in a very great measure synonymous with industrial effort, received in England an immense impetus. When literature and the arts in general awoke from the lethargy of the Middle Ages, then at last this land of ours began to realize her strength and natural resources, and the foundations were laid of that industrial supremacy to which we have so long made claim, and which we are determined to retain.

As a result of the mineral wealth and other physical characteristics of the North of England having attracted thither practically the entire cotton interests of the country, the majority of Londoners know very little, indeed, about cotton in the raw state, either as regards its cultivation or its manufacture. We are familiar from childhood with the terms distaff and spindle, not to mention spinster, but to most of us such terms remain abstractions, and I, therefore, ask your permission to briefly relate the history of cotton culture up to the time when precise statistical details become available.

Herodotus, Strabo, Arrian, Virgil, all, in various connections, make reference to "wool bearing trees," and there is ample evidence in their writings and elsewhere that the cotton plant was extensively cultivated in India, at any rate, long before the Christian era. Columbus, in 1492, found the natives of the Bahamas ready to barter skeins of cotton, and in Cuba he found cotton cloth extensively worn. In Egypt and in China cotton has undoubtedly been largely grown for many centuries, but in the case of Egypt it is since 1821, when Mehemet Ali introduced the Sea Island variety of the Gossypium Barbadense, that the cultivation of cotton has attained commercial importance, and in China, where the cotton is, moreover, of notoriously inferior quality, the adoption of cotton clothing dates only from the fourteenth century, garments of wool and silk having previously been almost exclusively preferred, and cotton cultivated only as an ornamental plant.

Cotton is cultivable between 45° of north and 35° of south latitude, which zone includes the whole of two continents, Africa and Australia, very large portions of America and Asia, and the European shores of the Mediterranean. The European output is comparatively insignificant, the Australian negligible, and it is by America (North and South), Egypt and India, that almost the whole of the world's supply is provided.

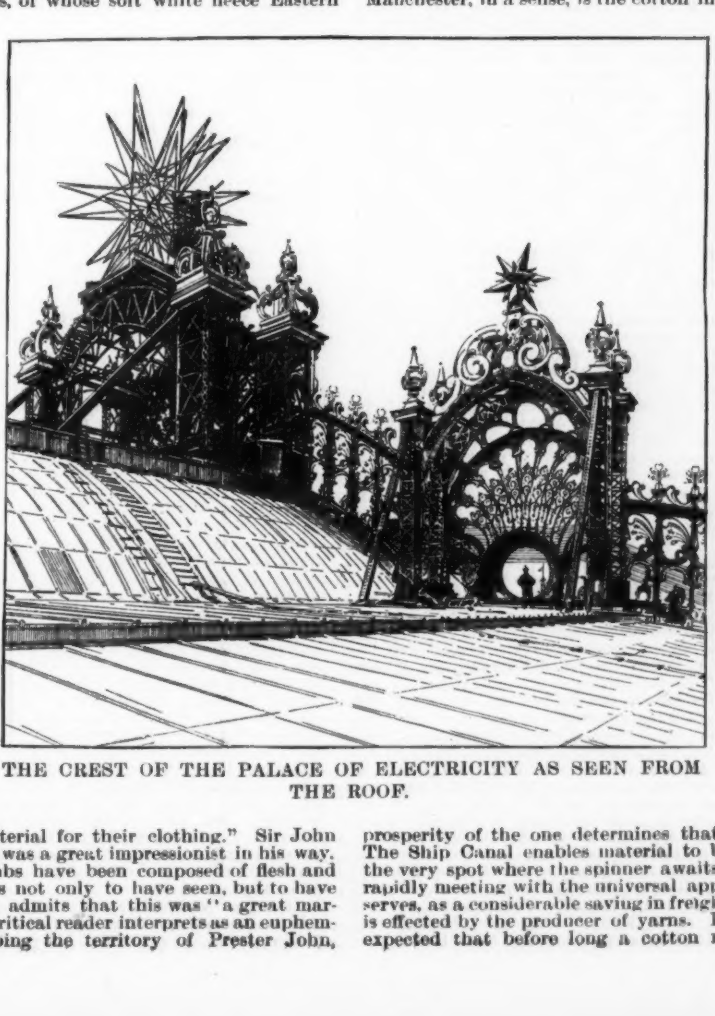
Like most of our other great national industries, the manufacture of cotton goods in England has been of slow growth. In the thirteenth century cotton was in general use among us for candle-wicks, but it was not until the growing demand for imported stuff in Elizabethan times stimulated industry and enterprise that we hear anything of cotton-yarn spinning. It is, in fact, not till 1641 that definite mention of it is made by Lewes Roberts in his little book, "The Treasure of Traffic."

The cotton plant, from the striking appearance of its blooms, naturally did not escape the observation of mediæval explorers in those lands in which it was cultivated. Many marvelous tales were told of the legendary "vegetable lamb," which, as one author expresses it, "grew on a tree bearing fruit or seed-pods, which, when they ripened and burst open, were seen to contain little lambs, of whose soft white fleece Eastern people wove material for their clothing." Sir John Mandeville, who was a great impressionist in his way, declares the lambs have been composed of flesh and blood, and claims not only to have seen, but to have eaten them. He admits that this was "a great marvel," which the critical reader interprets as an euphemism. In describing the territory of Prester John, however, Mandeville states that "men sow the seeds of cotton, and they sow it every year, and then it grows into small trees which bear cotton. And so do men every year, so that there is plenty of cotton at all times." The conviction expressed in the last sentence many of us nowadays would be extremely glad to share.

England was certainly one of the very last countries to adopt the cotton-spinning industry. In Spain, Bavaria, Netherlands, and Turkey, the industry was established before the end of the sixteenth century. Lewes Roberts, however, writes of the industry as having been established "at Manchester in Lancashire" for some considerable time. After referring to Manchester enterprise in connection with the importation or weaving of Irish yarn, he says, "Neither doth the industry rest here, for they buy wool in London that comes first from Cyprus and Smyrna, and at home worke the same and perfect it into fustians, vermillions, dimities, and other such stuffs, and not seldom send into forrain parts, who have means, at far easier terms, to provide themselves of the said first materials." We may be reminded by this passage of the fact that, until about 1780, the cotton imported into Great Britain came almost entirely from the Mediterranean, from Smyrna chiefly, a very little occasionally coming from the West Indies during the eighteenth century.

Manchester cottons were constantly mentioned in statutes of earlier date, but it is generally understood that these were a coarse kind of woolens, and, as a matter of fact, until 1773 linen yarn was used as the warp for nearly all cotton goods, and the production of unmixed goods was exceedingly limited. A great deal of confusion arises in the historical study of cotton from the constant use of "cottons" as a term for woolen fabrics, but it is considered proved that the manufacture of cotton goods was introduced into England toward the close of the sixteenth century by the Flemish Protestant immigrants, just as, much later, the Spitalfields silk-weaving industry was established by the French Protestant refugees after the revocation of the edict of Nantes.

In 1538, Leland states that "Mancestere, on the south side of the Irwell River, standeth in Salfordshire, and is the fairest, best builded, quickest, and most populous tounne of all Lancastreshire." In 1699, in which year the entire exports of the country was considerably under £7,000,000 in value, the cotton trade had become sufficiently productive to encourage the general erection of brick houses in Manchester, the population of which was then estimated at about 50,000; but that this prosperity was not wholly due to cotton is evident from the fact that two years later the exportation of woolen goods amounted for the year 1701 to £2,000,000, more than one-fourth of the whole export trade of the kingdom, while the cotton goods exported in the year did not exceed in value £20,000. In 1833, it is interesting to note that the cotton goods exports were nearly £19,000,000, and the woolen exports only about £6,500,000, while in 1896 the exports of cotton and woolen manufactured goods were respectively about £56,000,000 and less than £20,000,000. As an indication of the marvelous increase of production and of the relative importance of the two industries, these figures are worth quoting. A writer, in 1662, speaking of Leland, says, "He called Manchester the fairest and quickest town in this country; and sure I am it hath lost neither spruceness nor spirits since that time." It is because Manchester, in 1894, with the completion of the Ship Canal, began a new lease of prosperity, because, as a port, its wealth and importance are certain to become far greater than they ever could have been while it remained an inland town, that such impressions of old writers convey peculiar interest to us. Manchester, in a sense, is the cotton industry, and the prosperity of the one determines that of the other. The Ship Canal enables material to be consigned to the very spot where the spinner awaits it, and is now rapidly meeting with the universal appreciation it deserves, as a considerable saving in freight charges, etc., is effected by the producer of yarns. It is confidently expected that before long a cotton market will be



THE CREST OF THE PALACE OF ELECTRICITY AS SEEN FROM THE ROOF.

* Lecture delivered before the Society of Arts.

established in Manchester on the lines of the Liverpool "flags." Very many raw cotton transactions take place daily on the Manchester Exchange, and, with the improved facilities for the storage of cotton at the Pomona Docks, the advantages of a reliable business in "spot" cotton to the Manchester consumer are obvious.

Among cotton-producing countries, India has spun her own raw material from the very earliest times. The protectionist sentiment which, formulated in a statue of William III. forbade the importation of Indian printed calicoes for domestic use, either as apparel or furniture, under a penalty of £200 on the wearer or seller, is constantly in evidence in the history of the cotton industry, and no country has suffered more in consequence. It may be questioned whether it is not just because of that vigorous opposition which the cotton industry has encountered at every stage of its progress in this country that it has attained its magnificent prosperity; but in the eighteenth century, after the introduction of spinning machinery, the profits of the manufactured export trade to the Indies was so highly valued that in every possible way the native manufacturer of cotton goods was discouraged. The government attitude was not by any means that of the seventeenth century pamphleteer, who bewails the growing popularity of cotton calicoes because they are cheap, and recommends the prohibition of stage coaches on account of their injuring the proprietors of the inns on the road by conveying the passengers too quickly and at too little expense to themselves. We can, nevertheless, only regard as a perversion of national judgment the imposition of a duty of 10 per cent. upon Indian cottons imported here, while English cotton imported into India paid a duty of only 2½ per cent. In the eighteenth century nearly all the governments of Europe felt it necessary to prohibit or impede the importation of Indian cotton fabrics, and the result of this was necessarily that as a center of the cotton goods manufacture India deteriorated. The slow introduction of machinery and properly equipped mills has operated against the development of Indian yarn spinning and manufactures, and is still prejudicial.

When we come to the year 1781 we find the first imports of cotton from Brazil, the West Indian crops being unobtainable as a result of the war with France, Spain, and the American colonies. A very large increase in consumption stimulated production in Brazil, and, in 1788, the demand having grown immensely by this time as a result of the extensive adoption of machinery, the East India Company were urged to promote the importation of raw cotton from their territories. The result of this was unsatisfactory, for when samples came to be submitted Manchester spinners declined to buy—"the quality was unsuited." More than once large consignments of the East Indian product were rejected by spinners and thrown upon the hands of the producers, and it is only in comparatively recent years that the staple has been sufficiently improved, and enough care shown in the picking and various processes anterior to export, to enable Indian cotton to compete in the same markets with American. To come down to the present, the manufacture of textiles, and the cultivation of cotton for export are conflicting interests in India, though the conditions of both have suffered many changes in the past hundred years. India depends on her indigenous staple for the supply of her steadily increasing number of mills. Japan, more particularly, shows an eager demand for raw cotton from India. It has come to the point now that unless the cotton acreage of India, which has recently greatly decreased, is considerably extended, manufacturers and exporters will come into active collision, to the serious detriment of one class or the other, or of both. We are indebted to The Times of India for a valuable article which appeared last month on the cotton acreage, in which the importance of rapid and extensive increase is emphasized. Japan being India's best customer for raw cotton, and a constant and growing demand coming from that country, it is urged that the restriction of the cotton area involves a menace to the Indian manufacturer in every bale that is sent abroad. The writer continues: "While the cotton crop for the season ending June, 1899, was one of the largest on record, the one for this season will, there is no doubt, be one of the smallest; but leaving these two years out of our review, as polarizing extremes, an examination of agricultural statistics over a fairly long period of years, is not exactly reassuring. The fact is that while the area in India sown with crops of all kinds steadily increases, the cotton crop area remains more or less stationary; and, indeed, bears a less proportion to the whole cultivated area than it did many years ago. For instance, in 1884–85, the total area in British India sown with crops was 125,955,122 acres. By 1897–98 this area had expanded to 196 497,232 acres. In 1884–85 the cotton area was 8,521,178 acres, and in 1897–98 it was only 8,916,229 acres. The curve of cultivated area has, in some years, gone up very high. For instance, in 1890–91, in British India alone, it reached nearly 11,000,000 of acres, and in 1893–94 it touched nearly 10-500,000 of acres. But with the exception of last year the cultivated area has been steadily shrinking since 1893–94." . . . "So far as British India is concerned, the Government statistics estimate the whole cotton produce at about 3,000,000 bales, of which the mills in 1897–98 are estimated to have taken 1,301,000 bales. To state the problem roughly then—very roughly we admit—a doubled mill consumption would about knock the bottom out of our export trade, or a doubled export trade would render the mill industry an impossibility."

That in India either the culture of cotton or the manufacture of cotton goods will decay is scarcely conceivable, but while the natives of India in the past have produced incomparable handspun yarn, it is exceedingly unlikely that they will, for many years to come, produce anything in the mills that will compete with the finer counts of English yarn, such as are turned out by the more skillful class of English operatives. Our great dependency which has her share in the industrial prosperity which we may all assist—be it ever so humbly—in securing for the British Empire, and the imagination is powerless to grasp what India may be industrially in even half-a-century, given due development of her resources. But the centralization of the English industry in and about Lancashire, and the advancing technical education standard of the North of England, which is making rapid progress and bringing us on a level with the most enlightened nations on the Continent—these will give manufacturers here an immense advantage as regards the quality of products, howsoever much the Indian staple may be improved. As regards supplies, however, the day is not far distant when India will find more profit in the manufactured product than in the export of the raw material, that is to say, very little raw cotton will be left for export, even though the acreage be materially increased. India may be regarded as the home of cotton culture—she has been called the "cradle of the cotton industry"—and she may be considered entitled to the precedence I have given her, if only in deference to the antiquity of this market, but it must not be forgotten that it is from the United States that more than two-thirds of the world's supply was last year obtained, and that it is thence that a similar proportion will probably proceed for many years to come. It is this cotton culture perhaps more than anything else that has brought the United States into the forefront of commercial enterprise, by promoting constant contact with European peoples, and by stimulating industry and commercialism throughout the lengths and breadths of the country. It is truly "a great marvel," to use Mandeville's expression, that one of the first recorded importations of United States cotton, consisting of eight bags, received at Liverpool in 1784, shortly after Great Britain acknowledged the independence of the United States, should have been regarded by the customs authorities at Liverpool as a breach of the existing navigation laws. It was assumed that this cotton was the product of Brazil, or the West Indies, and the statutes did not permit the conveyance to English ports by the vessels of a foreign country of the products of other countries. It was doubted whether so large a quantity of cotton as eight bags could have been raised in the country adjacent to the port of shipment. It was the development of machinery toward the close of the eighteenth century that created an increased demand, which American cultivators found it well worth their while to supply. The inventions of Lewis Paul, Arkwright, Hargreaves, and Crompton, all conspicuous and venerated in the nation's economic Pantheon, so enormously advanced manufactures that while in the first half of the eighteenth century the quantity of cotton-wool imported seems to have a little more than doubled, and the value of the cotton exports to have not quite doubled; in the last twenty years of that century the imports of cotton increased eight-fold, and the value of the exports of cotton goods was increased 15½-fold.

When the Civil War of 1861–1865 was foreseen, in view of the terrible consequences which must ensue to the cotton industry of Lancashire, every accessible part of the cotton zone was ransacked for cultivable areas. Seed was sent broadcast to all who would experiment with it in likely regions, but the results were disappointing. During the cotton famine years prices rose so high that even the European acreage was enormously increased, speaking proportionately, and considerable quantities were shipped from Mediterranean ports. But generally, after a little adjustment had taken place, the relative importance of the products of the cotton-producing countries became again pretty much what it had been before the war and the cotton famine which accompanied it. Our dependence upon the American crop is relatively as great as it has ever been, and though Egyptain cotton meets with a growing demand from the spinners of the finer counts the crops available from the rest of the cotton-growing countries do not largely increase, and there is the same anxiety nowadays to discover, if possible, new areas of profitable cultivation that there was in the late fifties.

The exports from Brazilian ports last year, for instance, were under 200,000 bales, as compared with 214,000 in the previous year, and 278,000 in 1896–97.

It is probable that the United States will continue to absorb an increasing proportion of each crop in their own mills, as will India, and that the surplus for export will accordingly diminish. Whether Egypt, too, has a future as a manufacturing country is an interesting problem. But bearing in mind the very small consumption in this country of East Indian cotton—less than 2¾ per cent. of the whole output last year of 1,415,000 bales—and also the rapidly growing continental competition in yarns as well as in manufactured articles, with its tendency to reduce prices, the conclusion to be drawn is that the encouragement of cotton culture on a largely increased scale in every one of our colonies capable of undertaking it, and in fact in every area available for the purpose, is a national duty.

In this current year it is anticipated that the American cotton crop will not exceed 10,000,000 bales, as against 11,275,000 last year. Beyond that the crop will be considerably less than the autumn estimates indicated, there is still considerable doubt and anxiety on the subject. Lancashire spinners have largely followed the 11,000,000 bales' estimate of Mr. Henry Neill, of New Orleans, in virtue of his high reputation and remarkable success in previous years in predicting the yield. This estimate he has since reduced to 10,000,000 bales; but very few are now inclined to accept this reduced estimate, and if the deficit proves anything like so great as many confidently predict, something in the nature of a crisis must inevitably arise. In fact, the question of short time in the mills is under consideration in northeast Lancashire at the present moment. The plague and famine will have their effect upon the Indian output this year. Egyptian crops, owing to the state of the Nile, will probably be very much diminished next season, though the latest reports are more favorable. From various causes the confidence of spinners in reports from the other side, regarding the American crop movements, has been much shaken, and the situation is altogether of an exceedingly problematical character. I do not, however, propose to offer a speculative opinion on the American crop prospects. It is too late for any useful opinion to be expressed, and the remarkable and unprecedented divergence of responsible expert opinions, the paramount feature this year, is scarcely encouraging, while I am no authority on the subject, and could not speak as an expert.

There is this, however, to be said. On this side no one is able to regard seriously the present inflation of prices in New York, and it is anticipated that during the next few months speculators and manipulators will control the market. No one knows how to act for the best, and the Lancashire spinners buy only for urgent requirements. The same speculative intrusion which for a time demoralized wheat and rubber in turn has now affected cotton.

I should like to quote in this connection the opinion of an American journal, The American Ginner, published at Meridian, Missouri:

"The cotton crop of America, enlisting, as it does, the interest of every civilized country on earth, furnishing raiment to the nations, has been hitherto considered too vast in its proportions and too wide in its ramifications of influence to tempt the octopus. But it appears that the magnitude of the enterprise has been an inspiration and an inducement to the endeavor. The very greatness of the enterprise has seemed to invite rather than repel the endeavors of some who have achieved great things in other similar but smaller undertakings. It would seem as if stupendous success in the circumscribed field whetted the appetite for greater worlds to conquer, and there are many evidences plainly discernible to the intelligent observer who looks beneath the surface, that such an enterprise has been planned, and the process of extention begun. The Napoleons of finance who undertake these stupendous enterprises never make an assault vi et armis—the waiting siege, sapping, and mining, constitute their method of operation and approach to the citadel which they desire to capture. Once surrender the preparation of cotton for market to a monopoly, and where then is the hope of the producer or consumer? Once establish the warehouse system of storage, and who controls the market? These two agencies combined fulfil all needful means to accomplish what is known as a corner, and when they become generally adopted, the producer on the one hand must take the price offered, and the spinner on the other must pay the price asked, or the alternative. The grower's cotton must rot on his hands and a famine of cotton goods produced. . . ."

I will add no comment. It is curiously interesting to compare the exports of cotton from the United States a century ago with those of the present day. Baines, in his "History of the Cotton Manufacture," writing in 1834, describes as immense the American crops of the years 1819–1832, which ranged from about 300,000 bales of 300 pounds, to rather more than 1,000,000 bales of 300 pounds; in 1791, the entire exports of cotton from the United States was 189,316 pounds weight; last year the American cotton crops amounted to nearly 11,250,000 bales, averaging 487 pounds in weight, or considerably over 5,000,000,000 pounds weight of cotton.

It is unfortunate, seeing that the use of yarn for mercerizing processes has brought a great deal of business to the spinners of the finer counts in the Bolton district, that the Egyptian crop this year is likely to fall far short of the demand. Egyptian cotton commands a high price, and is a very bright feature in the outlook for that country's commerce. But there can be no kind of doubt that in a few years, when the irrigation system in process of adoption is thoroughly established, the cultivable area will be enormously increased. The crop prospect is this week reported to have very much improved, owing to the progress made in cutting the sudd.

There are students of political and social economy who compare the present age, following as it does on a period of the most active invention and scientific expansion, with those ages of degeneration, or of repose, which followed the fall of the Roman Empire and the Reformation. It is argued that the principle of evolution in cycles demands a periodical cessation from activity in industrial enterprise and in all other matters, and special application of this theory is made to the present condition of our national industries. But it is to be questioned whether sufficient allowance is made in speculations of this kind for the quite unprecedented changes in the whole economy of human affairs which the closing century has witnessed. There is no parallel in the history of the world for the advances comprised in the life of man since the age of Napoleon, to take the central figure of the period. Space has been in a great measure annihilated. The resources of steam and electricity have placed the life of the Antipodes in immediate juxtaposition to our own, and the obvious deduction is that such things as may appear requisite for the well-being of humanity, or any section of it, it is no longer in the power or discretion of any particular nation to withhold. It is in the nature of man to seek rest when his task is finished: nations, when they have accomplished a feat of invention, an industrial forced march, a miracle of contrivance, which has placed them in a position of relative superiority to their competitors, are prone to meditate awhile and soothe a leisure that is itself gratifying, in contrast with the effort concluded, with self-adulation for what has been accomplished. But no nation can now afford to do this thing with impunity. Whatever may be the ties which bind one people to another, the essentials of civilized life, and all life which are the basis of commerce, food, clothing, and shelter, control their domestic requirements, and ultimately determine their financial and political neutrality. Therefore, it is that the principle of the machine, untiring, unresting, has been imparted to human intercourse in general. Each new advance of science secures universal comprehension and application almost as soon as promulgated: woe be to the nation that ignores, or rejects, the signs of progress, for while the rapidity of advance is unprecedented, how shall it be in those dynasties of industry that decay?

This nation is not decadent, but we have been lacking in aggressive vitality, albeit we have served as the industrial model for newer nations, which have not failed to profit by our humor. But as we have been led by recent events to analyze the ethics and tendencies of our foreign policy, so also is this a critical period in our industrial life, and a fitting time to recognize the altering conditions. Commercial monopolies, howsoever acquired or maintained, the future will condemn as strenuously as the past, and to some extent the present, has upheld and upholds them; but where the element of transport, except as a factor in cost, becomes negligible, the world's supply of any kind of raw material whatsoever will necessarily be derived from those countries which can best produce it, and since in regard to cotton supplies an acreage of perhaps 40 mil-

lions, or a tract of land about half the size of England, would probably fulfil all requirements for a long time to come, so far as the ultimate future is concerned it is simply a matter of selection.

That the United States will ever cease to produce a large proportion of the world's cotton supply is most improbable, but that the United States will multiply its mills and consume an increasing proportion of its crop is scarcely a controversial statement. The question for England is whether, while we are in a position of supremacy as regards wealth and resources, our interests do not desiderate capitalization of all available new fields of supply for our industrial needs. The trend of commerce, sooner or later, will be to manufacture all articles of the world's consumption in the immediate neighborhood of the producing area of their material, and even under present conditions it is a curious anomaly that the model centralized industry, the cotton trade of Lancashire, should be established in a land that never has been and never could be made to grow cotton. But pending the development of the principle of manufacture on the fields of supply, which the annihilation of space—the salient fact of the nineteenth century, as it seems to me—is bringing into the region of practicability, our industry demands the utilization of every available area of supply, and the problem presents itself now very much as it presented itself in the fifties.

The climatic essential of cotton culture, equable but at no time excessive moisture, is hardly to be found in Australia, and, therefore, the experiments undertaken there have been at best inconclusive. Wool culture, moreover, provides a profitable industry to which the climate of this continent is peculiarly suited. But this is not the case with regard to a great part of Africa. In West Africa cotton has been cultivated by the natives for centuries. In 1890, cotton cloth from the Guinea coast was brought to England. Mr. Ellison, in his "History of the Cotton Trade of Great Britain," writing in 1886, estimates the quantity grown in Africa, apart from Egypt, at about 150,000,000 pounds, or 375,000 bales of 400 pounds, equal to 2·99 per cent of his estimate of the world's crops. To use his words: "A large quantity of cotton is grown in the coast places and interior of Africa, but one can only guess at its amount. As the natives are for the most part more economical than fastidious in the matter of clothing, it will, perhaps, be sufficient to estimate the requirements of all Africa at an average of 1¼ pounds per head per annum, or one-half the per capita rate adopted for India." He then estimates the population at 200,000,000, deducts from the 250,000,000 pounds, so obtained a probable total of 100,000,000 pounds imported in the form of cotton fabrics, and obtains the result stated, 150,000,000 pounds weight. African fabrics are coarse and useless for foreign consumption, but that the staple of the indigenous cotton is incapable of improvement is far from proven. The results obtained in Egypt in 1821, from Mehemet Ali's importation, would justify much more extended experiments on African soil.

I am deeply sensible of the privilege of appearing before the most critical, because the best-informed body in the kingdom. But I am naturally diffident in addressing your society, and it is possible that what I have said may appear to you to convey too little concrete information. On such a subject one is compelled to risk being either diffuse or parochial, and I have elected the former course. If I have in any degree failed to interest you, I trust that I have escaped the utterance of any statement or the expression of any sentiment which might mislead you, and that my paper, if only for the discussion it may be privileged to evoke, will not be without utility.

WORKING DRAWING OF AN ELECTRIC PHÆTON.

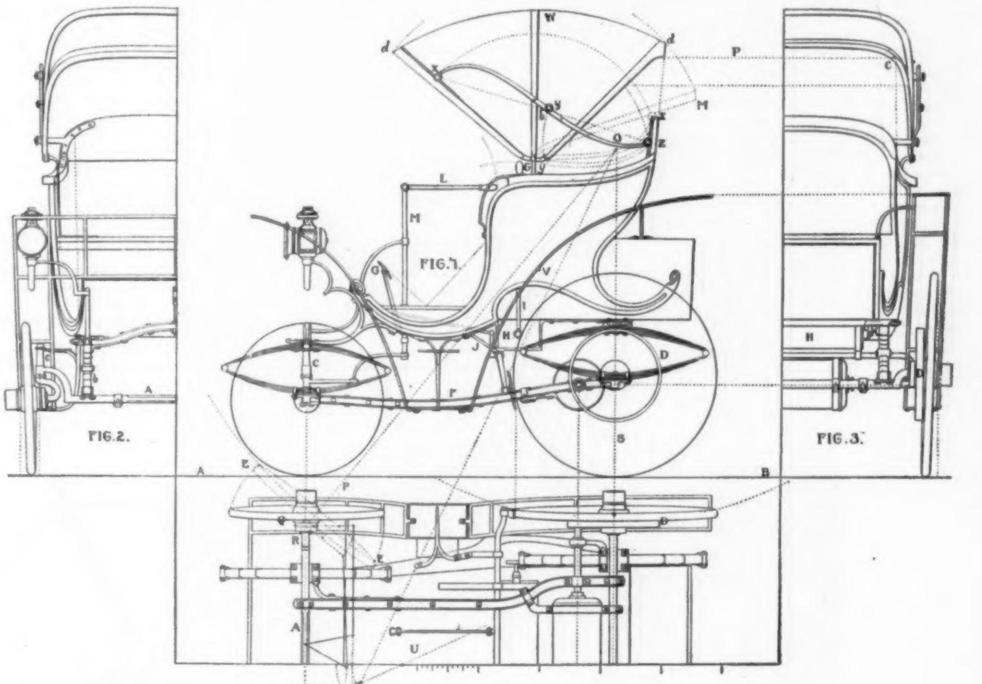
(Scale ⅜ inch to the foot.)

THE working drawing illustrates a design for an electric phæton for two persons, fully equipped with all the appliances that tend to the pleasure and convenience of the rider. The noticeable feature of the drawing, Fig. 1, is the nearer approach, in the design of the body, to the original conception of the phæton, and in this particular it is a conspicuous exception to the one fault so noticeable in the construction of automobiles, all of which look like the work of the mind and hand of one not accustomed to carriage drafting. Take, for instance, the electric stanhopes; they are practically the same in the lines leading up to the top, nor are they really stanhopes as originally built. They are more like the T-cart, or mail phæton body than anything else; but in this drawing we come as close to the phæton as the equipment of the carriage will allow.

The front elevation, Fig. 2, shows the width and position of the axle, the clipping on of the spring, the form of the perch, shape of the arched bar, which is clipped to the top of the springs, the position of the lamp, design of both dash and wing, width and contraction of the front of the body, which is necessary, because the width of the back end of the body is much wider than the front end, all of which must be shown in the working drawing of the body of this phæton. The track is 4 feet 10 inches. The swing of the wheel is in a height of 30 inches 1⅛ inches, in order to have the vertical spindle as nearly over the tire as possible. The mechanic can see that the principle by which we are guided in the work is the rational one in setting the axle. The weight which is on the axle, *A*, Fig. 2, through the spring, *b*, will keep the spindle, *c*, in the vertical position at *C* in the side elevation, Fig. 1, because if it moves it must twist the axle, *A*, which on a 1⅛-inch axle is not probable, although possible in an accident. The pivotal axle for the front wheels, is according to the best mechanics, a solution of the problem of steering or guiding the direction of the carriage, identical with the principal of steering a boat or ship, and is, as we now know, exactly opposite in both principle and method of that with the horse-propelled carriage, because if we do not pivot the front wheel to the main axle, *A*, Fig. 2, we must swing the wheel, axle and spring from a centric point placed either in the axle itself or directly above or directly below the center, but to cover the whole ground we may station this center back of the vertical plane of the transverse axle. We may transpose this pivotal center along the longitudinal axis of the horizontal plane to any convenient point, at the option of the draughtsman and when we do not pivot the wheel to the main axle by means of the "wim-wam" we must sacrifice the position of the step and wing of the front wheel, and at the entrance of the carriage we must consent to the resultant inconvenience which would follow; hence we indorse the pivotal front wheel as a means of steering the carriage in the most reliable manner. We can, if driven to it, steer the direction of the carriage from the hind wheels, but if we look into the matter we will soon discover the folly of such a decision, as it is better to distribute the intricacies of the mechanism of the running gear to a back and front position, so as to obtain room for each particular part, and thus divide in proportion the work for each end, and for each wheel and axle. In this way there will be space on the axles for the motor, spring, brake, perches, and for the steering gear, and we can then proceed to model a design that will be acceptable, but whenever we undertake to place all on either axle, then we have the spectacle of an over balanced model, an airy appearance at one end and a bulky load at the other, an incongruity that places all of the weight on one axle, leaving nothing for the other to do, and the absurd situation is conspicuous to the untutored which already is condemned by the carriage builder, and it is safe to say that, as a rule, the appearance of the pleasure carriage is the first consideration of the builder. If the appearance of the carriage does not suit the purchaser he will take an unusually long time to decide about possessing it. An ugly, badly shaped, badly proportioned carriage is a detriment to both builder and purchaser; there is no excuse for building an ugly appearing electric carriage.

Fig. 3 shows the elevation of one-half of the back, a situation which is both faulty and inconvenient, especially to a carriage mechanic, because in the first place there is more work on the plan than there is in either or all of the elevations; secondly, the ground upon which we consider to be a horizontal surface, is below the side; we cannot conceive of its being above, like the ceiling of a room. It is absurd to suppose that the vertical and horizontal axis of the drawings could ever intersect under such an incongruous arrangement of the plate.

We have drawn in plan the near side of the carriage, coinciding with the elevation, Figs. 1 and 2. In this plate we can clearly see the fixing of the motor to the axle and the perch, which is done in the best manner possible. Expense at this point should not be the first consideration, but instead the work must be so done that space is both used and economized, making the two perches contribute to the stability of the cylinder and the braces which support the armature to strengthen the perches. Bend the perch, *F*, of either hickory or ash, out of 1¾ × 2-inch stock; the ends abut the front and back axles. The plates, top and bottom, form the clip and yoke for its fixture to each axle alike. Take advantage of the close proximity of the solid spring flaps to turn off a brace from the bottom onto the side of the perch at the front, and to the bottom at the back, the latter being fixed with a clip, the former with bolts; this latter brace from the hind spring forms a box, within which the armature revolves. The bushing should be of brass, the wear to be taken up by means of a taper key. We can judge of the simplicity of the work, since we employ the use of the spring flap and the clips, which secure the springs, and which also fix securely the braces which support both perch and motor. In this way we avoid a great display of irons that would not be as good nor look as well, and which require a great deal of labor.



WORKING DRAWING OF AN ELECTRIC PHÆTON.

Scale, ⅜ inch to the foot.

mounted on a drop axle of 1¾-inch square steel, to which is clipped the spring to solid forged square-shaped flaps, spread to an outside width of 43 inches. The track of the wheel is 4 feet 10 inches, having a swing in the height of 40 inches of 1¾ inches. To the axle is first fixed the rear end of the bent hickory perch, plated top and bottom, the ends of the plates passing over and under the axle, and clipped and bolted. The cylinder of the motor is secured to the perch and axle, the armature of which is geared to a cog having the slots cut on the interior surface of the rim, *D*, Fig. 1, and not on the outside, as usual. This driving wheel is then clipped to each alternate spoke of the hind wheels. The center of the cog, *D*, is bored for a 6-inch hub, over which it fits. The outside surface, which is spoked as that of the wheel, coincides with the inside edge of the wood spokes of the coach-shaped wheel, and we may in the finished work of the carriage fix to the axle a dust plate, which will conceal and protect the gearing cogs of the armature and driving wheel; it will be necessary to know that it must be clipped to the axle, since the dust plate cannot revolve with the wheels. As it envelops the cogs of both, the cross position of the armature will dispute the way.

A projection in plan of one-half of the carriage mounted is shown by Fig. 4, as in the elevation. It is upon this that we make clear to the reader the form and the position of the parts shown in Figs. 1, 2 and 3. It is a projection derived from the length, width, and height of the elevations above it, hence it is stationed upon the horizontal plane, supposedly directly under Fig. 1, the side elevation, with the base line, *A B*, forming the edge of intersection of the vertical with the horizontal planes. This is not always the rule in automobile building: on the contrary, machine draughtsmen arrange the plan above, instead of below,

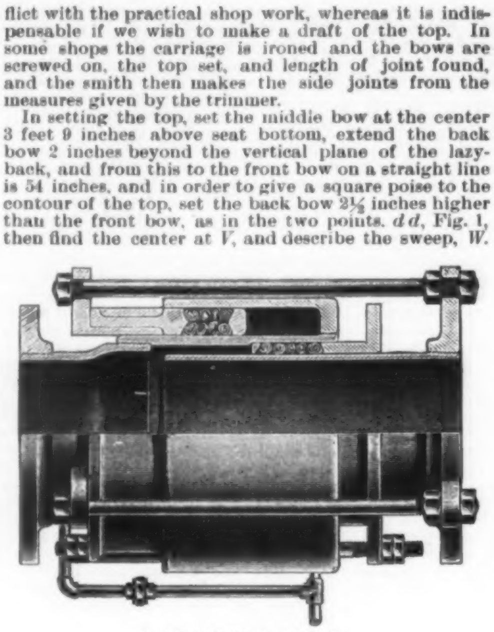
On this drawing is produced a reliable form of brake, one that is intended to stop the movement of the wheels in the shortest time, and with the minimum of exertion. The drawing shows that the shortest distance from the toe pad to the tire of hind wheel is from the shoe to the rod at *G*, Fig. 1. The shoe should be made of a thin plate of steel, shaped as shown in the side view, concaved slightly to friction with the rubber cushion of the wheel, and placed below the center of axle to obtain this friction without the vibration which would accrue if placed above that point. When this is done, if the weight lowers the body the brake shoe will travel away from the cushion of the wheel, but a half inch of motion at *G* will move the shoe toward the tire twice the amount, overcoming the loss without losing the pressure on the tire of the wheel. The square box, *H*, contains the controller, by which with the lever bar, *I*, the current is fed to the motor, and by which the carriage is started. The brake is the only means of stopping the motion when this current is turned off. The controller is held in the position shown by the braces, which are also made to take the main cross-rod of the brake. The place for this controller is the top when the cells of the batteries are removed. This controller is stationary, and when once fixed to the carrying crane need not be tampered with, as trouble is not likely to happen except through accident. These irons are bolted to the bottom of the floor, which is of hard wood, one-half inch thick, but the brace, *J*, which is the main stay of the brake rod, is bolted further out toward the shoe to the sills of the body. The reason why this controller is set in under the body in this position is to avoid interference of the spring; furthermore, there is no room for it in the usual place on the seat; the controlling bar, *I*, is mortised through the bottomside.

The steering gear, by which we guide the carriage in

any desired direction, is arranged so that if the handle bar, *L*, Fig. 1, is swung to the right the carriage will turn to that direction, the driver's position being on the near side of the carriage; the steering bar, *M*, stands in the center. The brake rod is stationed 6 inches from the center and toward the near side. The distance which the handle end of the bar, *L*, will swing to either side is 8 inches; the length is 18 inches. The handle is set above the seat bottom 10 inches. The ground space in which the carriage will turn is 24 feet, as the distance from the front wheel, *N*, is 12 feet to the common center, *O*, to which point in the vertical plane of the hind axle, prolonged for this purpose, is directed the square of the two front wheels, in a position locked to turn around the center, *O*, as shown by the two dotted lines, *P P*. To arrive at a correct knowledge of the plan of the steering gear, turn the front wheel, *Q*, in the position, *E E*, as backed against the spring, the limit of the angle, which revolves about the center, *R*. If through the center, *R*, we draw the line, *P*, at right angles to the chord, *E E*, prolonged until it cuts the line, *S*, the center of hind axle, the intersection thus found will be the point around which the carriage will turn. The first question which the mechanic asks is, "Is this the correct answer?" It is, because each wheel stands at right angles to this point, and a line drawn from the center of each wheel, as here clearly illustrated, will be at right angles to the rim of the wheel, and the longer the carriage is coupled up the greater will be the distance from the points, *E E* to *O*, and the longer will be the lines, *P P*, and the more will be the space required in which to turn, conditional that the degree of angle of the front wheel, *Q*, is not increased or diminished, as this angle is the starting point, as described above. It is necessary to find the direction of the two lines, *P P*, before we can describe the movement of the rods and pivots, and the distance that they will move on the steering gear, as shown in plan, locked in the position to which they must move when the wheel, *Q*, is backed, as it were, against the elliptic spring, which in practice we do not propose that the rubber tire shall quite touch. The drawing is quite plain on this point, and the reader can inform himself of its accuracy by the use of a pair of dividers. We mention that at the point, *T*, Fig. 4, a slot is cut in the end of the rod, *U*, which is necessary to a smooth working mechanism and also avoids the necessity of adding the more complicated device of a hinge method of movement. We have seen several kinds of steering gears, but none more simple or accurate than this, but no matter the kind used, the principle here shown and explained is present in all, because the wheel, *N*, travels in a larger circle than either of the other three, hence the angle to which the rods of the steering gear will turn this wheel is much less than the wheel, *Q*, but the principle here laid down is present in the locking of all carriages, whether horse or motor propelled. But to end the matter, we have only to place one point of the dividers upon the center, *O*, and extend the other to the rim of the wheel, *Q*, and it will cut the points, *E E*, and likewise the wheel, *N*, as well as the hind wheel; this is the correct answer to the question involved.

The drawing of the top and all that goes with it is governed by rules that should be known in order to do good work. A technical knowledge will not conflict with the practical shop work, whereas it is indispensable if we wish to make a draft of the top. In some shops the carriage is ironed and the bows are screwed on, the top set, and length of joint found, and the smith then makes the side joints from the measures given by the trimmer.

In setting the top, set the middle bow at the center 3 feet 9 inches above seat bottom, extend the back bow 2 inches beyond the vertical plane of the lazy-back, and from this to the front bow on a straight line is 54 inches, and in order to give a square poise to the contour of the top, set the back bow 2½ inches higher than the front bow, as in the two points, *d d*, Fig. 1, then find the center at *V*, and describe the sweep, *W*. Place the center of the goose neck, *G*, in such a position that it will be equally distant from the points, *d d*; from this point the front and back bows will be of equal length, insuring a good appearance when the top is folded back. Then station the elbow prop as at *Z*, and from the center, *G*, turn the front bow to the position, *M*, as per dotted lines, and on the edge station the top prop a trifle back of the elbow props, as shown at *X*, and also station the same on the front bow as at *X*, and from *Z* to *X* produce a straight line, as dotted in, and proceed to find the point of knuckle, *b'*, the center of the dotted line from *Z* to *X*. Then draw a straight line from *Z* to *X*, at the elbow to the top prop of the lowered front bow, divide this line into three parts, take one part and place it from *b'* back to the knuckle, and it will be the point desired, as shown on the drawing; then decide the shape of the side joint, which is done as follows: From the center, *Z*, describe the center of the knuckle from *y* to *y'*, fixing the knuckle on this curve as near midway between the top of the lowered front bow and the arm rail as possible; then from the elbow, *Z*, to the knuckle, *y'*, draw the lower half of the joint corresponding to the curve of the arm rail, and from the top prop of the lowered front bow at *X* to the knuckle, *y'*, draw the top half of the side joint corresponding to the curve of the lower half of the side joint, as shown in Fig. 1, and when the joint is open the shape will be as shown in the compound curve, *Z* to *X*. This is the practical way of finding the true shape of the side joint, so that the curves of the joint in the folded top may correspond. If we design a side joint to look well when in an open position, without reference to its folded position, we carry the point of the back bow at the height of the line, *P'*, across to the back elevation, Fig. 3, and from the width of the lazyback erect the vertical line, *C'*, to where it cuts the line, *P'*; the intersection will be the point of projection to the back bow, as shown in Fig. 1. If we take the point, *Z*, of the elbow prop, and describe this point from the center, *G*, the goose neck, until it cuts the back bow, and from this point horizontally across to the back bow of Fig. 3, and then vertically down to the elbow prop, we obtain the length of the back bow when lowered onto the prop.—The Hub.



EXPANSION JOINT.

EXPANSION JOINT.

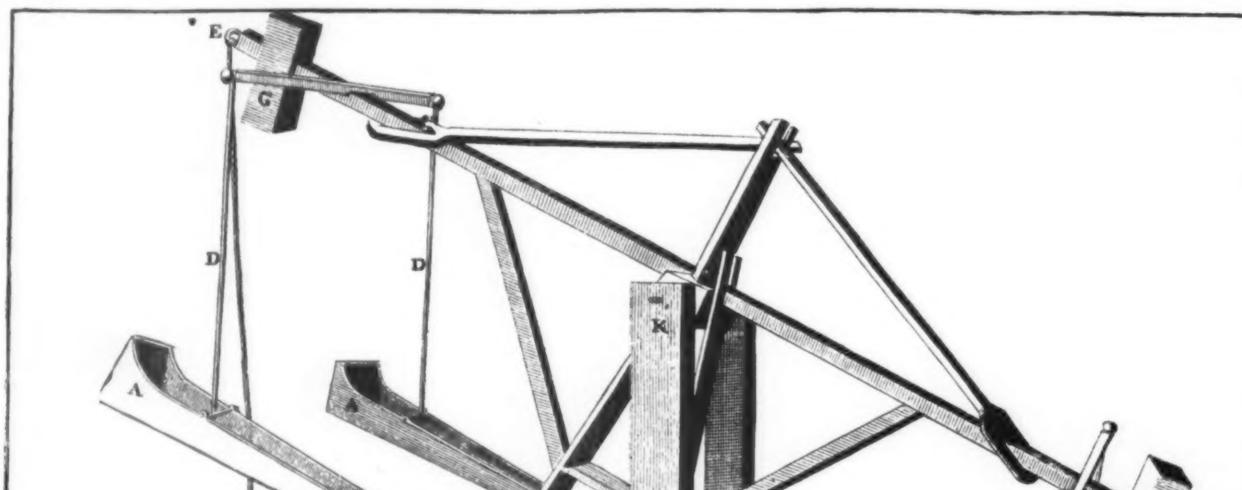
MESSRS. BROWN & CO., Manchester, England, have devised a balanced expansion joint, which should be a useful fitting to steam users in general, and central stations in particular. It is designed, says The Electrical Review, of London, to prevent the forcing apart of joints in steam pipes, and the illustration will show its action. The joint is surrounded by an annular chamber of cross section equal to the steam pipe, in which a tightly packed ring acts as a piston. Steam is admitted to this chamber by means of a by-pass. The tendency would be to force out the piston, and so draw the ends of the pipe closer together, but as the steam in the pipe and in the chamber is of the same total pressure, each force neutralizes the other, and the joint is rendered secure under all ordinary circumstances. The joints are made of steel forgings, excepting the glands, which are cast, and the first cost is very little greater than that of an ordinary joint.

MACHINE FOR DRYING A MARSH, FOR EMPTYING A BATTERDEAU, OR FOR DRAWING WATER FROM A SHALLOW PLACE.

THE four large gutters, *A*, which are to carry water from the reservoirs, *B*, to the reservoir, *C*, are, to this effect, attached, through their extremity, to the edge of the reservoir, *C*, and are suspended by their large end through four movable iron bars, *D*, from the large walking beam, *E F*, which has its bearing point at *K*, at which, as shown in the figure, it is provided with three counterpoises, *G*, *H*, *I*.

In order to set the walking beam in motion, and, at the same time, the four large gutters that are suspended from it, it is provided at its two extremities with ropes, *L*, *M*, that are pulled by two men in the same way that bell ropes are. Following such motion, the four gutters, *A*, in pairs, continually and alternately descending to the reservoirs, *B*, and rising therefrom up to a point a little beneath the reservoir, *C*, scoop up, in abundance and in a short time, the water that it has been proposed to raise.

It must be observed that the counterpoises, *G*, *H*, *I*, greatly facilitate the operation of the machine, and that they serve as a balance to it for keeping the beam, *E*, *F*, in motion.—From Recueil d'Ouvrages Curieux de Mathematique et de Mechanique, 1733.



MACHINE FOR DRYING A MARSH, FOR EMPTYING A BATTERDEAU, OR FOR DRAWING WATER FROM A SHALLOW PLACE.

MORE FREIGHT TRANSPORTATION IN THE UNITED STATES THAN IN ALL EUROPE.

COMPARING the amount of railroad freight transportation in the German Empire and the United States, we find lately that for every inhabitant a ton of freight was carried 388 miles in Germany, and 1,541 miles in this country, which led to the conclusion that transportation is a very much greater element in production here than anywhere else. Further investigation makes it evident that the amount of railroad freight transportation (ton mileage) for the 77,000,000 of people in the United States is very much greater than for the 360,000,000 of all Europe, and probably as great as for the whole world besides, with 1,408,000,000 of people. This may seem incredible, but, though the amount of traffic in some countries cannot be definitely ascertained, the statement is capable of proof.

By the latest accessible reports the numbers of ton-miles in several European countries were, in millions:

France	9,500
Belgium (State)	1,711
Germany	21,032
Austria	6,529
Hungary	2,714
Italy	1,363
Russia	17,157
Total	60,006

The report of Germany is for 1898, of France, Belgium, Austria and Hungary, for 1897; for Italy, 1892; for Russia, 1896.

The only important omission here is Great Britain, whose traffic reports are worthy of the dark ages of railroads. But though we cannot say how great its ton-mileage was, we can safely say that it could not have exceeded certain figures.

The data which we have for Great Britain are the number of tons carried, and the mileage of freight trains. Reducing to tons of 2,000 lb., in 1898, 423,990,000 tons of freight ("merchandise and minerals") were carried in the United Kingdom, and freight trains ran 169,253,027 miles.

Freight trains in England are what we would call small; but the lightness of their average loads is likely to be exaggerated if we bear in mind the "goods trains" alone; "mineral" trains are often very long, and of the 424,000,000 of tons of freight shipped in 1898, no less than 300,000,000 were "minerals." Assuming the impossible, that the average freight train-load was as great there as here (226 tons), the British ton-mileage would be 38,335,000,000, and this would require an average haul of 90 miles—in so small a country inconceivable. In this monstrous country the average haul is 130 miles, in France 76 miles. It seems much more probable that the British average haul and average train-load are half as great as the above, and the ton-miles would then be less than 20,000,000,000, or nearly the same as in the German Empire, with its much greater area and population, and its very much smaller facilities for transportation by sea.

Our figures for Belgium are for the state railroads only, which were then about five-eighths of the country's mileage.

There remain Spain and Portugal, whose traffic must be much less than that of Italy; the Scandinavian countries, with a very light freight traffic; Holland, Switzerland and Turkey, etc., whose traffic would make but an insignificant addition to the great figures of the other countries.

Altogether these unreported countries can hardly have more than 3,000,000,000 of ton-miles. If we add this to the most exaggerated estimate of the British traffic, we have for all Europe a grand total of 101,341,000,000 of ton-miles.

Now, in 1898, the freight traffic in the United States was 114,078,000,000 of ton-miles. It is probable that the British traffic is so exaggerated in this estimate that the true amount of traffic in all Europe was no more than 83,000,000,000, in which case it is exceeded by 37 per cent. in this country, and the excess is probably as great as all the other freight traffic in the world outside of Europe.

In Asia probably nine-tenths of the railroad traffic is in India, and its railroads had 6,421,000,000 of ton-miles in 1898. Canada has an important traffic in proportion to population; but in South America there is but a light traffic, except in the Argentine Republic. While statistics are not accessible, enough is known to make it probable that the railroad freight traffic of the United States equals that of all the world besides, as it is certainly much greater than that of all Europe.—Railroad Gazette.

GERMAN COMMERCIAL INTERESTS IN CHINA AND JAPAN.

UNTIL recently, Germany had taken no great part in the commercial development of China; but with the acquisition of a sphere of influence, together with industrial concessions of various kinds, German interests in the Celestial Empire have become considerable.

In 1898, German exports to China amounted to $10,424,000. The imports into Germany from China for the same year amounted to $5,164,600. German warehouses are located in Hongkong, Swatow, Amoy, Fuchau, Chefoo, Tientsin, and Shanghai—altogether about one hundred and five establishments, of a total value of $30,000,000; these render material assistance to German trade. These houses ship great cargoes of tea, rice, and feathers to Germany in return for machinery and iron products of every description.

In Shanghai, there are German cotton and silk mills to the value of $1,000,000. In addition to this, German capital is invested in a great many English enterprises; for example, the docks, shipping and insurance companies of Shanghai. These interests are valued at $18,000,000. The German Shantung Railroad Company has a capital of $3,000,000. The interests of private individuals of German nationality in China are valued at $2,000,000. In Shanghai, the German Asiatic Bank does business with a capital of about $3,000,000. With the exception of a small vineyard in Chefoo, which is valued at $25,000, the Germans own no plantations.

In Japan, there are sixty-five German warehouses doing business, with an aggregate capital of $5,000,000. German industrial enterprises in Japan are valued at $3,000,000. German interests in Formosa, which is ruled by Japan, amount to $1,500,000. In Japan's sphere of influence in Korea, about $1,500,000 German capital has been invested.

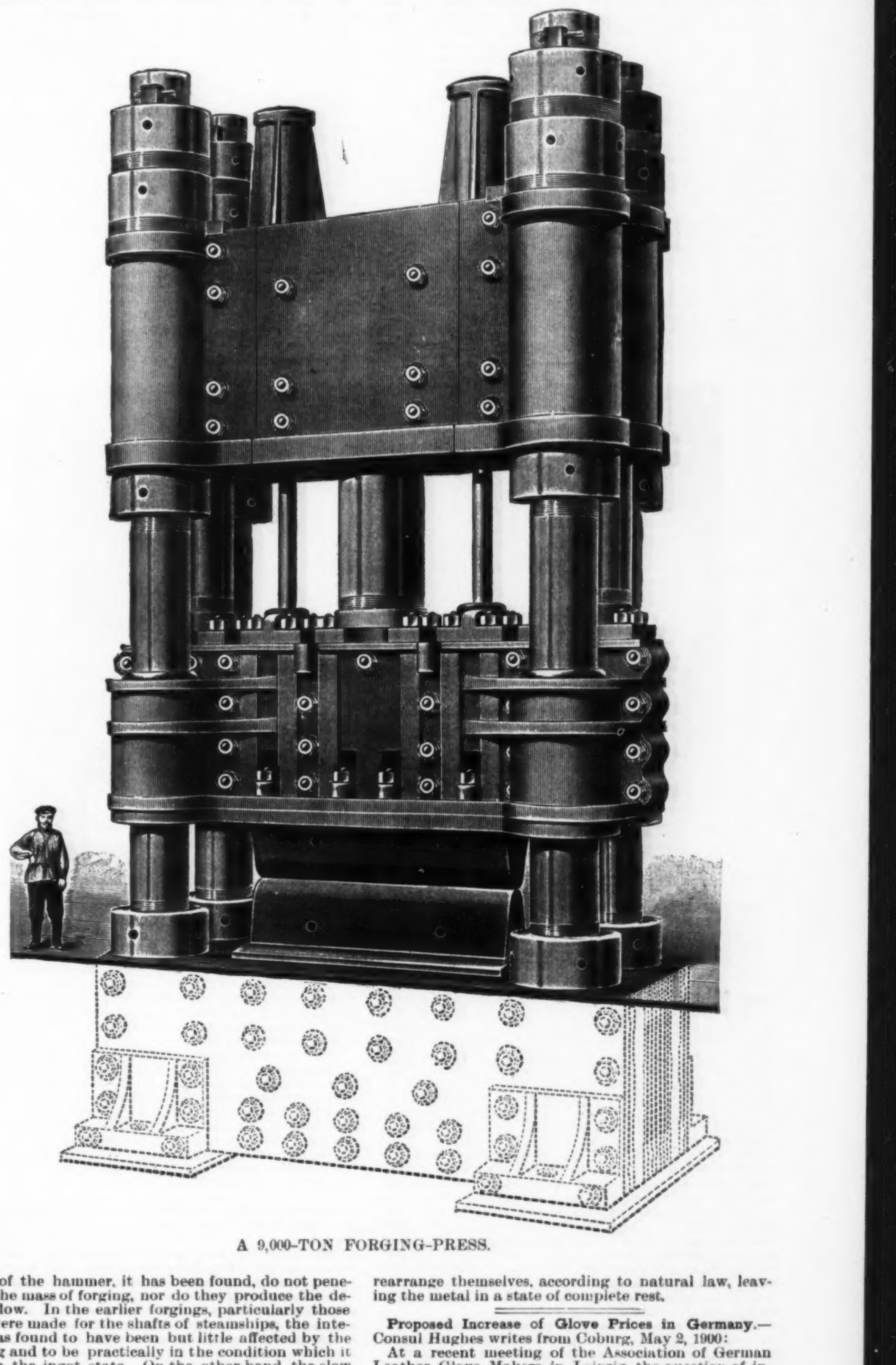
In the aggregate, German interests in China and Japan are not far from $90,000,000 in value.—Ernest L. Harris, Consular Agent at Eibenstock.

A 9,000-TON FORGING-PRESS.

THERE has been a radical change in the last few years in the methods of producing heavy forgings. The blow of the steam hammer has given place to the steady pressure of the hydraulic press. The pressure applied in forging a piece of steel should be of such a character as to penetrate to the heart of the metal, causing a flow of the metal to occur throughout its whole mass. Naturally the flowing of the metal requires that the proper amount of pressure shall be maintained for a sufficient period. The sharp, heavy blows of the hammer, it has been found, do not penetrate the mass of forging, nor do they produce the desired flow. In the earlier forgings, particularly those that were made for the shafts of steamships, the interior was found to have been but little affected by the forging and to be practically in the condition which it held in the ingot state. On the other hand, the slow protracted pressure of the hydraulic press gives ample time for the molecules of metal to flow over and around one another, and the effects are felt throughout the whole mass of forging. The center metal being the hottest is squeezed out, and the finished forgings have on their ends the convex shape which shows that the flow of the metal has been satisfactory.

Hydraulic presses are made of enormous sizes. That pictured in the illustration exerts a pressure of 9,000 tons. The press is constructed upon the same general lines as the fluid compressor. The hydraulic cylinder is carried in the upper head, and the travel of the piston is controlled by a hydraulic lever in the hands of an attendant. An indicator shows the number of inches of stroke of the piston, and as the same length of stroke is maintained throughout a complete revolution of the forging in the press, the piece is roughed out with an accuracy as to diameter and line that is remarkable, and greatly reduces the subsequent labor in the machine shop.

As it is impossible to complete the process of forging such large masses of metal in one heat, and the result of reheating, cooling and working at so many different temperatures is that the forging, as completed, is full of forging strains; to relieve these it has to be subjected to a final heat treatment which is known as "annealing." In annealing the forging is very carefully and slowly heated to a temperature which is slightly above the recalescent point (the point at which all crystallization is destroyed, and the molecules are thrown into an amorphous condition), and it is then allowed to cool very slowly. As it cools, the molecules rearrange themselves, according to natural law, leaving the metal in a state of complete rest.



A 9,000-TON FORGING-PRESS.

Proposed Increase of Glove Prices in Germany.—Consul Hughes writes from Coburg, May 2, 1900:

At a recent meeting of the Association of German Leather Glove Makers in Leipzig, the question of increasing prices of leather gloves was discussed. Stress was laid on the fact that the manufacture of leather gloves was one of the few industries which had not, up to the present, participated in the extraordinary general advance of German commerce. In view of the rise in wages and the high prices of raw materials, this branch of industry makes a very trifling profit. Factories are overwhelmed with orders, so that at present they are in a position to dictate prices to the purchasers. It was decided to send circulars to all members of the society, as well as to outside makers, urging them to increase their prices, without, however, binding themselves to any fixed percentage of advance.

BLACK LIGHT AND THE ULTIMATE FORMS OF MATTER.

Dr. Gustave Le Bon is continuing his studies upon "black light," which he began four years ago, and under this general name, now designates the following radiations:

1. Invisible Phosphorescence.—Owing to this, it is possible to photograph, in utter darkness, bodies that have not seen the light in eighteen months.

2. Invisible Radiations of Great Wave Length.—These render it possible to photograph through opaque bodies by the camera.

3. Metallic Emissions.—These discharge electrified bodies and make an impression upon photographic plates, through obstacles, but act only at a short distance. Although such emissions were the first with which Dr. Le Bon occupied himself, they are the ones of which the study has made the least progress.

Ordinary metals have a very feeble emission. M. Becquerel and other observers have discovered that uranium, thorium, etc., are by far the most active. It is also recognized that what are called radio-active salts possess the same properties to a still greater degree. Some of these compounds, such, for example, as radiferous chloride of barium, are spontaneously phosphorescent. In studying these latter salts and upon seeing at what point their properties are modified by heat, humidity, etc., Dr. Le Bon has been led to conclude that the properties of radio-active bodies are due (as is more and more admitted with regard to phosphorescent ones), to very mobile chemical reactions that are capable of taking place in solid bodies (salts or metals) under the influence of very simple causes, such, for example, as very feeble variations in temperature.

In order to justify this hypothesis, it became necessary to find bodies capable of becoming radio-active under the influence of well determined reactions. Such was the object of the work that Dr. Le Bon undertook, and the results of which he not long ago published in the Comptes Rendus of the Academy of Sciences and has since extended into a memoir.

Among the bodies that exhibit what are called radio-active phenomena, the author mentions especially sulphate of quinine. If a thin layer of this salt be placed upon a sheet of paper and the latter be laid upon a plate of metal heated to about 120°, the quinine will soon become phosphorescent, and the phosphorescence will be extinguished in a few minutes. If the paper be then removed and placed upon a cold body, the salt will become luminous again, and still further so if its surface be blown upon. At the end of a quarter of an hour, it will cease to shine. Upon heating it anew, it will again shine, and this series of operations may be repeated indefinitely. If, while it is cooling, it be placed upon the plate of an electroscope, it will discharge the latter rapidly, even through a material obstacle, such as a thin sheet of metal. The reactions that then occur are very simple. The heated sulphate of quinine becomes dehydrated, and, when cooled, becomes hydrated. The phosphorescence and the various phenomena of radio-activity accompany the hydration and dehydration through simple variations in temperature. Many bodies exhibit the same properties as sulphate of quinine. Reactions very different from hydration may produce phenomena of radio-activity, as Dr. Le Bon has likewise demonstrated.

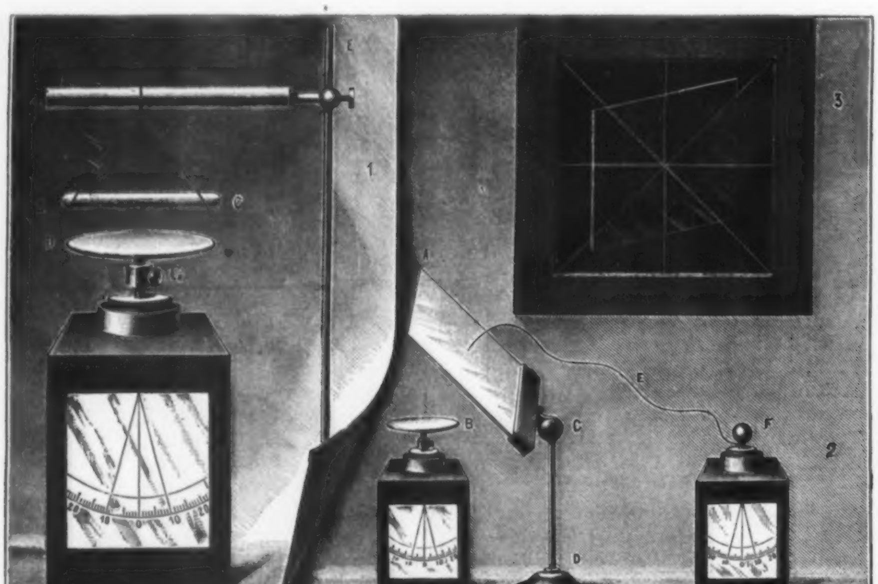
In what do the radiations emitted by radio-active bodies, that is to say, by various metals such as uranium, zinc, aluminium, etc., or salts such as radiferous barium chloride, quinine sulphate, etc., consist? Is there radiance really due to radiations, that is to say, to a phenomenon occurring in the ether, and, like light, propagating itself by undulations? This was thought to be the case for some time, but all physicists now agree (as Dr. Le Bon was the first to sustain, three years ago) that the alleged radiations do not become polarized and are not refracted. They are, therefore, not radiations, and hence it becomes possible that they are due to an emission of matter allied to cathodic emanations. But this matter, which traverses material bodies, discharges electrified ones, makes an impression upon photographic plates, etc., can be neither a gas nor a vapor. It even greatly differs, according to Dr. Le Bon, from the "ions," that is to say, the molecules dissociated by electricity. This dissociation is such that the infinitely small particles designated by the name of atoms, are infinitely great with respect to this ultimate form of matter, and that is why bodies might emit them indefinitely without sensibly losing their weight. The fact that these particles behave like electric currents, as is proved by their deflection by the magnet and their property of rendering the air a conductor of electricity, demonstrates that they possess a great velocity. All these experiments, says Dr. Le Bon, in terminating his memoir, show that these dissociated atoms, these particles of immaterial matter, which are capable of traversing the most material obstacles, represent an ultimate form of matter, that is, entirely different from those forms that chemistry makes known to us. Here, then, we have a new world full of mystery offering itself to the investigations of experimenters.

We represent herewith a few of the apparatus employed by Dr. Le Bon in his new experiments.

At No. 1 of the figure is seen the tube, *BC*, of metal in which are inclosed the bodies under experiment. The particles produced by the chemical reactions, such, for example, as that of water upon phosphorus, traverse the walls of the metal in order to discharge the projection-electroscope, *DG*.

No. 2 represents the formation of effluvia capable of traversing material obstacles through the action of light upon certain newly cleaned metals, such as magnesium, zinc, amalgamated copper, etc. A mirror, *AC*, made of one of these metals and mounted upon a foot, *CD*, electrically insulated, is connected through a wire, *E*, with a discharged electroscope, *F*. The mirror is placed above a charged electroscope, *B*, and exposed to the sun. Under the influence of the light, the electroscope, *F*, becomes charged, while *B*, becomes discharged. This shows the conductivity established between *A* and *B*, by the emission of effluvia. The same apparatus (the electroscope, *F*, and the wire, *E*, being suppressed) serves to prove that these metallic effluvia traverse material obstacles. When, between the mirror, *AC*, and the plate of the electroscope, *B*, we interpose a thin sheet of tin, a body but slightly sensitive to light, the discharge takes place through this metal, thus showing that the latter has been traversed by the effluvia emitted by the mirror, *AC*, under the influence of light.

No. 3 represents the polariscope devised by Dr. Le Bon for proving, through the absence of double refraction, through Iceland spar, of the images formed upon a photographic plate, that the effluvia which emanate from what are called radio-active bodies, such as uranium, are not radiations comparable to those of light. An apparatus analogous to this had already been used by Dr. Le Bon, for proving the polarization of invisible light.—For the above particulars and the engraving, we are indebted to La Nature.



Dr. Le Bon's Apparatus for Showing the Passage, through Material Obstacles, of the Effluvia of Dissociated Matter Produced by Chemical Reactions, and by the Action of Light upon Metals, etc.; and for Demonstrating that such Effluvia are not Analogous to Light.

Venezuelan Duties on Rum, Wheat, and Drugs.—Consul Plumacher sends from Maracaibo, under date of May 4, May 7, and May 10, 1900, respectively, copies of decrees affecting the importation of rum, wheat, and certain drugs. The first prescribed that after April 20, 1900, the introduction through the custom-houses of the Republic of sugar-cane liquors or rum of foreign manufacture was to be temporarily permitted; such articles to pay an import duty, even if introduced from the Antilles, the amount prescribed for those liquors comprised in article 5 (1·50 bolivars per kilogram, or 28·9 cents per 2·2046 pounds).

The second provided that from the 15th of May, wheat in grain imported through the custom-houses of the Republic should be taxed according to the third class of the import tariff (30 centavos per kilogram, or 5·8 cents per 2·2046 pounds); and that the amount stipulated in the war tax on flour should also be levied on this article.

The third stipulated that after April 23, the substances called paste (extract of campeche), boric acid, and borax or extract of soda, not comprised in the tariff, should also be included in the third class, whenever introduced through the custom-houses of the Republic.

SELECTED FORMULÆ.

Blue-Black Ink.—

Gallic acid	2	ounces.
Iron sulphate	3½	"
Aniline blue	1	drachm.
Water	10	pints.

Heat the gallic acid in 5 pints of water. Dissolve the iron sulphate in a quart of water and add to it the gallic solution, stirring well, and then add the aniline dissolved in the remaining water.

Black Laundry Ink.—

Copper sulphate	35	parts.
Silver nitrate	15	"
Ammonia water	50	"
Potassium tartrate	10	"
Caustic soda	10	"
Dextrin	10	"
Sugar	5	"
Lampblack	1	"
Distilled water	80	"

Dissolve the copper sulphate in the ammonia water, and add the silver nitrate in powder. Warm the water, and add the soda, dextrin, and, when dissolved, stir in the lampblack. Mix the two solutions with persistent stirring.

Black Ink for Rubber Stamps.—

Nigrosin	1	ounce.
Glycerin	2	drachms.
Tannin	4	"
Silica solution (water glass)	q. s.	
Water to	8	ounces.

The tannin and soluble glass prevent the ink running in the fiber.

Red Ink for Rubber Stamps.—

Fuschin	2	drachms.
Distilled water	10	"
Acetic acid	2	"
Alcohol	12	"
Glycerin	10	ounces.

Dissolve.

Invisible Ink.—

Cobalt chloride	25	grains.
Glycerin	5	minims.
Distilled water	240	"

Dissolve the cobalt in the water and add the glycerin. Writing done with this ink is invisible on paper until heat is applied, when it shows blue. If allowed to become damp the writing disappears again.

Tamarind Pastiles.—

Tamarind pulp, concen.	1	pound.
Sugar, in fine powder	9½	ounces.
Jalap, in powder	¾	"
Starch, in powder	6½	"
Oil orange flowers	5	minims.

Mix together and roll out to thickness of about ¼ inch; cut into tablets weighing ½ drachm each. These may be covered with chocolate paste if desired, for which we append a formula below:

Chocolate powder	20	parts.
Sugar, in powder	70	"

Mix and make into a thick paste with—

Mucilage gum arabic	30	parts.
Rose water, a sufficiency.		

This paste is applied with a brush and dried, first in a warm room, and then in an exsiccator at a temperature of 100° F.

Salad Dressing.—

Salt	½	ounce.
Sugar	1	"
Salad oil	2	"
Eggs	2	"

Emulsify and add—

Tincture capsicum	20	drops.
Mustard	½	ounce.
Malt vinegar	6	"

Mix. —American Druggist.

Laundry Starch Gloss.—

Boric acid	5	parts.
Borax	3	"
Stearin	1	"
Beeswax, white	1	"

Put into a capsule, add sufficient of a solution of sodium hydrate (liquor sod causticus) of 20° B., and boil until a homogeneous liquid is obtained, then evaporate to dryness under a low heat. The dry product is then mixed with the finest rice starch, in the proportion of 1 part to 10 parts of starch. This produces the so-called "Glanzstärke" used in the finest German laundries. Properly prepared and properly applied, the preparation leaves nothing to be desired, either in the polish or stiffness of the laundry clothing. —National Druggist.

Preparation of Petroleum Soaps.—The saponification of petroleum is easily effected through the agency of carnauba wax, or of beeswax, and we believe that soaps carrying as high as 25 per cent. of petroleum are now commercially manufactured by processes in which carnauba, beeswax, or Japan (myrtle) wax play a prominent part. It would not pay you to attempt to make a soap such as you describe, unless you are prepared to go into it on a large scale, as the boiling processes require especial apparatus, skilled help, etc., but you can make enough for your trade by the use of soap, already made, as a base. Try the following, which was suggested by a French pharmacist, whose name escapes us, some two or three years ago:

Petroleum	5	parts.
Beeswax, refined	4	"
Alcohol, 90 per cent.	5	"
Castile soap	10	"

Put the petroleum in a suitable vessel, along with the wax and alcohol, and cautiously heat in the water bath, with occasional shakings, until complete solution is effected. Add the soap, finely shaved or powdered, and continue the heat until it is dissolved. Remove from the bath, agitate the vessel until the contents begin to "set," then pour into moulds.—National Druggist.

TRADE NOTES AND RECEIPTS.

Decolorization of Lard.—Into the liquid lard of 75 to 80 degrees of Celsius introduce powdered calcium chloride, work the mixture through vigorously, and place it in a filter press, by which the added substance is expelled together with the coloring iron salts.—Chemiker Zeitung.

Creme Simon.—For preparing the perfume for creme simon, the Pharmaceutische Centralhalle gives the following receipt:

Genuine musk, 1 gramme; cumarin, 1 gramme; vanillin, 1 gramme; heliotropin, 0·25 gramme; iris oil, 1 drop; neroli oil, 0·25 gramme; cinnamon oil, 1 drop; clove oil, 1 drop; tincture of benzoin, 8 grammes, and spirit to make up 30 grammes.

Preparation of Soy.—In preparing soy proceed as follows: Macerate for two days after the mushrooms have been squeezed, 1,000 grammes of champignons, yellow boletus, etc., 100 grammes of spirit, 500 grammes of water, and 3·5 grammes of cooking salt, next press. The residues are macerated another day with a mixture, composed as before, of spirit, water and cooking salt; both extracts are mixed, filtered and evaporated to the consistency of syrup.—Pharmaceutische Zeitung.

To Detect Aniline Blue in Flours.—As some flours give a bread of yellowish color, the millers add a slight quantity of aniline blue to the flour during the bolting, which dissolves in making the bread and modifies the color of it. Probably this admixture would never have been noticed if some granules had not at times remained undissolved, thus being plainly visible in the loaf.

For the detection of aniline blue, Violette recommends to take a deep plate, laying a piece of filtering paper on it and pouring a layer of water, 1 millimeter in height, on top. When a flour containing aniline blue is sprinkled on, soon little black dots appear which quickly increase in size, changing into blue round spots, darker in the center.—Neueste Erfindungen und Erfahrungen.

To Restore Dry Batteries.—In order to restore an ordinary dry battery to usefulness, when exhausted, all that is necessary is to put a number of holes in its sides and bottoms.

This is best done and in the simplest way by driving in common wire nails by means of a hammer. After the battery is then set in a vessel with acidulated water it will again give a current at once.

A cell thus treated will have as long a life as a new dry cell.

If a whole battery of dry cells is to be renewed in this manner, each cell has, of course, to be put separately into a vessel with fluid, since its case constitutes one of the electrodes. If vessels conducting the electric current are used for the liquid, care has, of course, to be taken to insulate them among each other.—Neueste Erfindungen und Erfahrungen.

Action of Carrots upon Sour Wine.—In the south of France carrots are employed as a corrigent of sour wine. The carrots are cut in slices, which, strung on cords, are hung into the sour wine. Sarcos has treated a claret, which had already lost 1·6 per cent. of alcohol, in this manner. Its amount of acid estimated as sulphuric acid, had risen from 3·24 to 10·163 grammes. The wine, about 20 liters, kept in a wickerwork bottle, was treated with sliced carrots for one month. After that time the acid only amounted to 9·065 grammes, and after another treatment with fresh carrots, fell to 8·330 grammes per liter. In another case the process was successful with white wine, the quantity of acid decreasing from 6·46 grammes to 4·998 grammes in the liter. The wines did not undergo any change in their chemical composition, but acquired a very pleasant sweetish taste, reminding of carrots. Mycodermaceti is not destroyed by the carrots.—Süddeutsche Apotheker Zeitung.

Formalin Mouth Wash and Tooth Paste.—According to the "Rundschau," formalin mouth wash is prepared as follows:

Dissolve 50 grammes of formalin—40 per cent. formaldehyde—in 1,000 grammes of the purest spirit, next grind with 200 grammes of tincture of benzoin, 50 grammes of tincture of myrrh, 3 grammes of peppermint oil, 2 grammes of aniseed oil, 1 gramme of cinnamon oil, 15 drops of Ceylon cinnamon oil, and 2 grammes of cochineal powder; mix all intimately and filter.

Formalin tooth paste:

Mix 30 grammes of formalin—40 per cent. formaldehyde—into 1,000 grammes of very pure whiting by gradual grinding, next add 200 grammes of powdered orris root, 50 grammes of magnesium carborate, 100 grammes of soap powder, 10 grammes of peppermint oil, 2 grammes of bergamot oil, and 1 gramme of lemon oil, and make into a paste with about 700 grammes of glycerin chemically pure.

Instead of 10 grammes of peppermint oil, one may take only 5 grammes, whereupon 8 grammes of menthol is added.

A New Beverage.—Various attempts to produce an oxygen-water were unsuccessful, says Dr. Wender in the Zeitschrift für die gesamte Kohlensäure Industrie, because oxygen alone does not impart to water that agreeable taste which is essential in a beverage that is to become popular. Now the Sauerstoff Fabrik, at Berlin, has succeeded in producing, with the aid of carbonic acid, a compound water, which possesses not only the pleasant taste of acidulous water, but also has a high therapeutic value, owing to the oxygen it contains.

The preparation of this oxygenated water is an easy matter, for any manufacturer of mineral waters. It is based upon the fact that a portion of the carbonic acid may be crowded out by oxygen. The product is prepared by impregnating the water mixed with salts, first with carbonic at 4 atmospheres, then with oxygen up to 8 atmospheres, and drawing off at 6 atmospheres. The water is perfectly clear and possesses a very agreeable, refreshing and yet mild taste. The additional cost is very slight, being hardly 10 pfennigs (2½ cents) for 570 bottles. The oxygen necessary for preparing the water is sold in a compressed state in steel bottles, like liquid carbonic acid, so that any apparatus may be used at once for preparing this water without alteration.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

New Railway in West Poland.—The Warsaw-Vienna Railway Company has been authorized to build a line from Warsaw, via Lodz, to Calish and Skalmerjitze, as well as a connecting line between the new one and the Vistula railway line, in Warsaw. The authorized capital is 125,000 shares of $50 and 4 per cent. bonds (without guaranty of the government). The shares mature in 1932 and the bonds in sixty years. The railway is to be constructed within three years and will be about 165 miles long. It will run through the Warsaw, Petrokov and Calish governments, which contain 4,144 square miles, with a population exceeding 60,000. Joining the Prussian lines near Stchipiorn and crossing densely populated localities (70 to 100 persons to each square kilometer), the new line will connect the towns of Blone, Sohatchev, Lovitch, Lodz, Lask, and Sieradz, and such prominent manufacturing centers as Zgierz, Pabianitze, Zdunska Vola, Blashki, and Opatovsk. In the Blonsk district, the railway will run near vast and numerous brick works; in the Sohatchev and Lovitch districts, near beet-root sugar works, and distilleries, and chemical works; and it will cross a rich industrial district between the burgh Zgierz, the town Lodz, and the burgh Pabianitze, where great cloth manufactories and weavers workshops are located, besides numerous distilleries and brick works. The construction of this line will greatly improve the industries in the places mentioned. In addition to its local importance, this line will be the shortest route for goods coming from Kovel and Brest to Warsaw and Lodz, as well as to Posen, Hamburg, Breslau, Saxony, and the Silesian mining district.—W. R. Holloway, Consul General, at St. Petersburg, May 9, 1900.

Railroad Accommodations in Central Europe.—As the present summer will witness a great exodus of travelers from the United States to the International Exposition at Paris and to Europe in general, a few words concerning some of the accommodations and conveniences of travel in central Europe may be of interest and value.

As is probably known, the railroads of Prussia and Saxony carry four classes of passengers, and those of southern Germany (and Europe generally) three classes. The rate of travel in the several classes is approximately 8, 6, 4, and 2 pfennigs per kilometer, a pfennig being about one-fourth of a cent and a kilometer approximately two-thirds of a mile.* The slow trains carry all classes of passengers, while the express trains carry only the first and second—sometimes the third. As traveling on a fast train is considered a luxury, an extra ticket, or Zuschlag, must be purchased for that privilege.

In general, tickets are valid on the days of purchase only; but excursion tickets good for three or ten days—the limit depending on the distance—can be obtained at all times at any station, and the ticket will be stamped "zurück," which means "return." The price of such round trip is always the price of the ticket for one way in the next higher class—i. e., a ticket good for second class one way is valid for third class going and returning; one good for first class one way is good for second class both ways; but a round trip first class costs usually the price of first and third one way.

The above remarks pertain to travel in general, but there are certain special arrangements which can be taken advantage of and which accordingly deserve mention:

(1) In Wurttemberg, it is possible to purchase a ticket or pass for the railroads of that kingdom only, valid for fifteen days, the prices being, respectively, 45, 30, and 20 marks ($10.71, $7.14 and $4.76). This would enable a traveler to travel as he pleases anywhere within the limits of the kingdom and stop at any station as long as he pleases, all depending on the time of expiration of the ticket.

(2) In Switzerland, an arrangement like the above was introduced two years ago, immediately after the main lines of travel came into the possession of the Swiss government, and is called the "general abonnement." A passenger desiring one of these tickets, which is in reality a pass for money paid, can obtain it at any station after having given due notice, which at the main stations need be but two hours in advance. These passes are issued for fifteen days, thirty days, three months, and for longer periods of time, the most popular form being the fifteen-day ticket, which is offered for 60 francs ($11.58) first class, 42 francs ($8.10) second class, and 30 francs ($5.79) third class. To obtain one of these general abonnements, it is necessary to present an unmounted photograph, which will be affixed to the ticket as a means of identification and to render the ticket non-transferable. Five francs (96 cents) must also be deposited, which will be refunded if the ticket is returned to any station within a half day after the limit has expired. When it is considered that the cost of a ticket from Basel over the St. Gothard Railroad to the Italian boundary line and return is almost as much as the price of one of these fifteen-day passes, the advantage of procuring a ticket by means of which the whole country can be visited and all except a few private and mountain railroads patronized is obvious.

For many years, Baden has been considered a model State in Germany, on account of its enterprise and generally progressive spirit. This is seen especially in the railroads, which are equal if not superior to any in Germany. Some years ago Baden introduced a system of "mileage books," which is very popular among all classes of people. These books, called "Kilometerhefte," are sold for 60, 40, and 25 marks ($14.25, $9.52, and $5.95), respectively, for the three classes, good for members of a family or firm for one year from date of issue, and good for 1,000 kilometers (621·37 miles) on the State roads of Baden and for express trains, without extra fare. While 1,000 kilometers may seem a long distance, and hence the purchase of a kilometer book may seem inadvisable, such is not the case, as can be readily learned by studying the distances stated in the time table—e. g., the distance from Heidelberg to Basel is 252 kilometers (156·5 miles) and from Basel to Constance 145 kilometers (90 miles), from which it immediately becomes evident that one kilometer book would not suffice for a party of three even when traveling one way only from Heidelberg or Mannheim to Constance via Basel. The cost for a trip of 1,000 kilometers in Baden on the express trains, purchasing tickets as you go, is 91, 64, and 45 marks ($21.65, $15.23, and $10.71) respectively. These books can be obtained at a moment's notice at any station; no photograph is required—simply the signature—and 1 mark (23.8 cents) will be given if the book is finally returned at any station.

A general round trip to suit the wishes of the individual traveler, who may plan for an extended journey greater than 600 kilometers (373 miles), can be arranged for by applying at any railroad office a few days before the start is to be made. A blank form indicating the various lines and distances intended to be patronized is filled out, and a special little ticket book, called Fahrscheinheft, is issued to meet the demands of the case. The cost will be found to be reduced by from 10 to 20 per cent., and the limit of the ticket is forty-five days if the distance to be traveled is from 600 to 2,000 kilometers, and if more than 2,000 kilometers (1,243 miles) sixty days. This form of ticket can be obtained for a round trip, not only including the States of Germany, but also Austria, Hungary, Switzerland, Scandinavia, and other countries of Europe.—E. Theophilus Liefeld, Consul at Freiburg.

* 100 pfennigs = 1 mark (23·8 cents); 1 kilometer = 0·62136 mile.

Improvements in Circular-Knitting Machines.—An improvement in circular-knitting machines has been patented by Messrs. Bettney & Hammersley, of Nottingham, the object being the production of a circular-knitting machine which will produce plain and ribbed fabric, changing automatically from one to the other, or from one class of rib to another, without stopping the machine or removing the needle loops from one needle to another. These changes may be made on any number of needles, and needles have independent action, and the machine has reciprocating motion, which enables heels and toes to be made.

Another improvement wherein a seamless tubular fabric may be knit and the needles fed by a single thread—the fabric having at the same time regular woven or knit portions, and openwork or lace portions, the same extending throughout the length of the fabric—has been patented in Great Britain by H. Brown, of Pennsylvania, and consists of a knitting machine with frame cylinder and one set of needles only, which may be arranged in sets of short and long latched needles. The feed is carried by a regular cam cylinder, which is provided by an auxiliary cam, adapted at alternate revolutions of the cylinder to raise both long and short latch needles, so that the thread in one instance will rest below the latches of the short latch needles only, whereas, in the other case, it will rest below the latches of both sorts of needles. By this arrangement of needles and cams, openwork designs in variety are made.—S. C. McFarland, Consul at Nottingham.

Profits of German Farms.—Consul-General Guenther writes from Frankfort, April 23, 1900:

For the purpose of furnishing information with reference to new commercial treaties, investigations concerning the profitableness of a large number of farms have been made by the authorities in the Kingdom of Wurttemberg. Ninety-four were selected, including the smallest and those of several hundred acres. The appraised value amounted to $2,970,000; the average value per acre, to $225, varying from $75 to $850. The average profit per acre was $1, or 1·72 per cent. of the total appraised value. The several establishments, however, showed very different results. Of the ninety-four farms, nine worked with a loss. Of the remainder, only sixteen returned interest on the working capital; nineteen yielded 5 per cent. on the working capital, and 3 per cent. on the investment for buildings; fifty yielded 5 per cent. on the working capital and 3 per cent. on the capital invested in buildings, and in addition an income on the lands ("Grundrente"), which latter in two instances amounted to 5·17 per cent.

Electric Power Wanted in Greece.—Consul McGinley writes from Athens, May 14, 1900:

From reliable sources, I have learned that the Athens and Piræus Railway Company must, according to conditions in its franchise, adopt electricity as the motive power for its trains within the next three years. This road extends from the quay in Piræus to the business center of Athens, some 5 miles, three-fourths of a mile of the distance being through a tunnel under a portion of the city. A Belgian company which owns and operates a steam tramway between Athens and Piræus, via Phaleron, also wishes to adopt electric power for its trains; but how soon it desires to make the change has not been learned. Each road has a very large passenger traffic, especially in the summer. A company of Athens has been trying to secure the contracts for fitting these roads with electric power. I have been informed that the president of the first-named company has gone to the exposition at Paris to examine the electric contrivances on exhibition there and to endeavor to secure the best possible power for his road.

Canadian Horses for Africa.—Commercial Agent Johnson, of Stanbridge, under date of June 1, 1900, reports that the South African war has opened up a new market for Canadian horses, and prices have almost doubled. One cargo of 713 was to leave Montreal on the 29th of May on the steamship "Lugano" and another on June 6 on the Devona. This vessel's capacity is 875 head, and it will take forty cattlemen to care for the animals. Owing to her coal capacity, the "Devona" will not be compelled to touch at any port on the long voyage. Mr. Johnson adds that these two shipments will almost drain the section of good horses.

German Tradesmen at the Paris Exposition.—Consul Monaghan, of Chemnitz, May 4, 1900, writes:

A motion has been brought before the Reichstag to select men from different trades and send them to the Paris Exposition, in order that they may make a thorough study of the branches which they represent. It is proposed to appropriate at least $75 for each one. A great many cities and districts in Germany have arranged to send such men to Paris. Some will pay particular attention to hygiene, illuminating appliances of all kinds, methods, of transportation, and canalization. The Chemnitz representatives are to study the methods in vogue in London for conserving and utilizing the smoke given off from large factories,

A great quantity of the coal consumed in this city is of the so-called soft variety, and gives off a soot that is very destructive to the external appearance of houses. The German experts will also converse with the representatives of the exhibiting nations, and find out what their countries are most in need of. The knowledge acquired by these men will be of unquestionable value in the development of German industrial life.

A New Substitute for Caoutchouc. — Vice-Consul Murphy sends from Magdeburg, May 3, 1900, translation from Deutsches Handels Museum, as follows:

The chemist W. F. Reidl has recently exhibited to the London Society for Chemical Industry a substitute for caoutchouc and gutta-percha called "vevril." Vevril is said to be composed of nitrocellulose mixed with linseed or castor oil. This mass, which is said to resemble the grade of caoutchouc known as "Para," is obtained by mixing 1 liter of nitrocellulose with 2 liters of oil. Castor oil yields a better product than linseed oil. The utilization of the material is affected by pressure or the influence of heat. An easy way to use vevril is to soften it with a solvent and then cause the solvent to evaporate. Vivril is said to be preferable to American caoutchouc, in that it does not injure copper.

New Automatic Shuttle in France.—Under date of May 8, 1900, Consul Atwell writes from Roubaix:

I am informed that in the course of five or six weeks there will be on exhibition at the Technical Institute of Roubaix an invention of Mr. Paul Clement, of Wasguehal, the director of the weaving establishment of Messrs. Lefebvre & Bastin. This invention can be adapted to any armure or Jacquard loom for fabrics with a woof; it consists in the employment of shuttle and bobbin, and is designed to automatically replace the shuttle when the thread of its bobbin is nearly exhausted. It is regarded as more simple in construction and consequently less costly than the Northrup invention. The advantages are summed up as follows: It is easily regulated; makes loosely woven fabrics without defects; defects in delicate fabrics are avoided and the selvage is perfect; waste of warp is reduced to a minimum; the production of each loom may be increased from 20 to 25 per cent., the speed attaining from 180 to 200 strokes per minute; and the hand work is diminished, as one weaver can attend to several looms. This invention is already in use in one of the large factories of Roubaix.

Machinery and Tools in the Caucasus.—Consul Schumann sends the following from Mainz, May 16, 1900:

French and Belgian capital is largely interested in industrial undertakings in the Caucasus. In 1898, the export of manganese iron ore from the Caucasus amounted to 20,000,000 poods (361,120 tons), and recently a number of new mining concessions have been granted.

The most important of the new French companies, whose chief industry is the mining of manganese and copper ore, is the Société Industrielle du Caucase, whose main offices are at Tiflis. The demand for mining machinery, tools, and instruments of all kinds is very great.

Canned Meat Imports into Germany.—Consul Worman, of Munich, under date of May 10, 1900, writes:

The German agrarians who have labored to bring about by legislation the exclusion of prepared meats are confronted with the problem of how to keep canned meats out of the country, when there is a commercial treaty with Italy permitting the entry of such goods. This can not be abrogated until the end of 1903, when the trade compacts with Austria-Hungary, Belgium, Switzerland, Russia, Roumania, Servia, and Italy, will terminate. The treaties with Japan and Turkey will not terminate for some time after 1903.

Telephone Improvements in Germany.—Under date of May 5, Consul Worman, of Munich, reports:

A syndicate has just been formed under the auspices of the Bank of Darmstadt, to bring into practical use certain telephone improvements that have been tested in government offices. These inventions are to make it possible to retain the spoken word and to repeat it as freely as desired; to use the same wire for simultaneous conversation by different parties; to repeat the same conversation at various points; and to strengthen the sounds so as to make the long-distance telephone operate with better results.

Motor Vehicles in Munich.—Consul Worman writes from Munich, May 1, 1900:

The Bavarian government has just set aside the city ordinance preventing the use of automobiles on the streets of Munich. This opens up one of the best German cities for American manufacturers of horseless vehicles of every sort, and wide-awake agents should be promptly sent to this field; so promising because of the large class of wealthy residents. Munich is the third largest city in the German empire. The streets are well paved, bicycles are popular, and horses dear. This opening should not long be neglected by American enterprise.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

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